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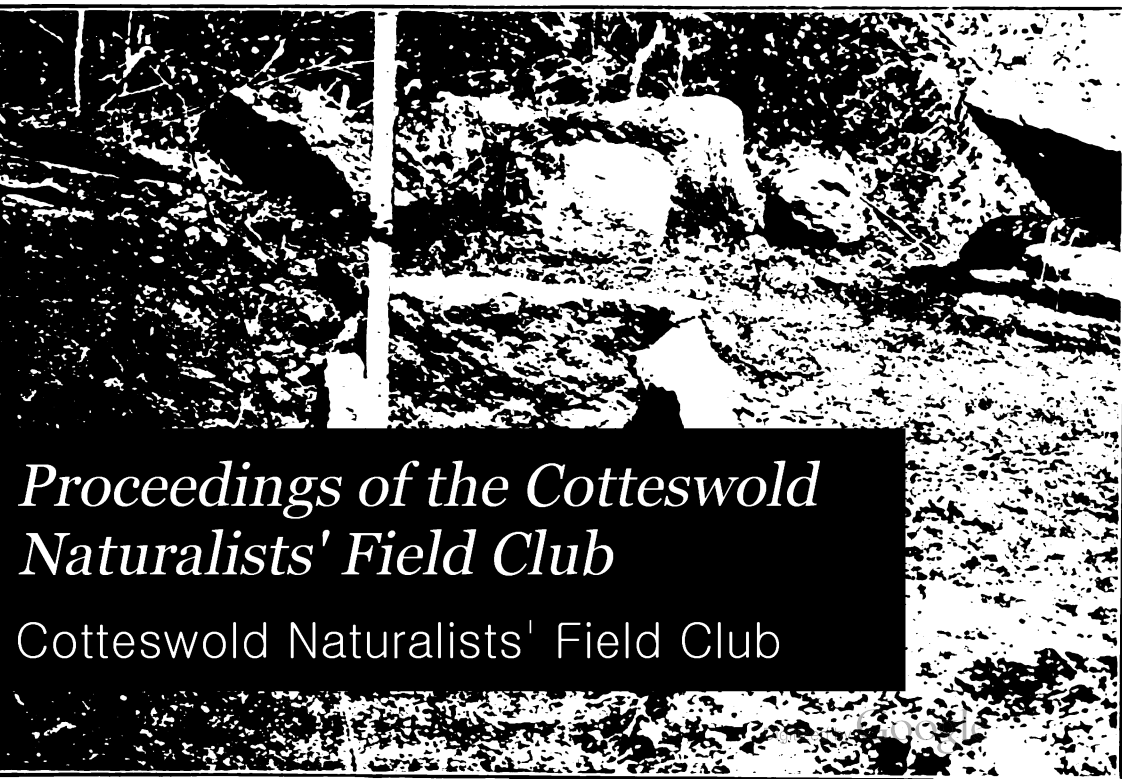
Fig. 1. DOLMEN AT GOKÂK, BELGAUM DISTRICT, BOMBAY PRESIDENCY.



*Proceedings of the Cotteswold Naturalists' Field Club*

Cotteswold Naturalists' Field Club

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ANTICLINE IN THE CARBONIFEROUS LIMESTONE AT CHEPSTOW.
*(From a Photograph.)*

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# PROCEEDINGS

OF THE

# COTTESWOLD NATURALISTS'

# FIELD CLUB

VOLUME XV.

Part I., 1904. Part II., 1905. Part III., 1906.

GLOUCESTER : 1904—1906.

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OF THE

# COTTESWOLD NATURALISTS'

# FIELD CLUB

PRESIDENT

REV. WALTER BUTT, M.A.

HONORARY SECRETARY

L. RICHARDSON, F.G.S.

Vol. XV. Part I.

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H. KNOWLES.

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## RULES OF THE CLUB

1.—The Objects of the Club are to study the Natural History and Antiquities of the County and the adjacent districts.

2.—The Club shall consist of a President, Vice-Presidents (not exceeding seven in number), an Honorary Secretary, an Honorary Treasurer, and Honorary Librarian, and Honorary, Ordinary and *Ex-officio* Members.

3.—Before anyone can be elected a Member he must be duly proposed and seconded at an Ordinary Meeting, and come up for ballot at a subsequent Meeting; one black ball in ten to disqualify.

4.—The Entrance Fee shall be £1. The Annual Subscription of Ordinary Members shall be Fifteen Shillings, due in advance on the first day of January.

5.—Any Member in arrear with his Subscription for the year is liable to removal from the list of Members.

6.—No Member shall be entitled to a copy of the Proceedings whose Subscription is one year in arrear.

7.—The Club may admit a limited number of Honorary Members (see Rule 2), whose scientific work entitles them to the distinction, and who must be elected at the Annual Meeting.

8.—The Executive Council for the Management of the Club shall consist of the President, Vice-Presidents, the Honorary Secretary, the Honorary Treasurer, and Honorary Librarian, all of whom shall retire at the Annual Meeting, but are eligible for re-election.

9.—The Annual Meeting shall be held in the early part of each year, at which Meeting the President's Address shall be read, the Financial Statement of the Honorary Treasurer shall be presented, and the Officers shall be elected, and the dates and places of the Field Meetings be fixed; but the arrangements for the Winter Meetings shall be left to the Executive Council.

10.—The Club shall usually hold yearly four Field Meetings, and also four Winter Meetings for the reading and discussion of Papers. At the Field Meetings any Member may introduce one Visitor, and at the Winter Meetings more than one; and at the Winter Meetings the term "Visitor" may include ladies. Members must give due notice to the Honorary Secretary of their intention to be present at any Field Meeting, and should any Member, having given such notice, fail to attend, he will be liable for his share of the expenses.

11.—The Council may at any time call a Special General Meeting of the Members. Upon the requisition of any eight Members being sent to the Honorary Secretary, a Special General Meeting shall be convened; and any proposition to be submitted shall be stated in the Notice. Not less than seven days' notice of any such General Meeting shall be given.

12.—The Club shall use its influence to promote the preservation of all antiquities and to prevent, as far as possible, the removal of scarce plants and the extermination of rare species of the flora or fauna.

Adopted at the Annual Meeting of the Members at Cheltenham, April 27th, 1896; and revised at the Annual Meeting at Gloucester, April 23rd, 1901.

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# ANNUAL ADDRESS

TO THE

# COTTESWOLD NATURALISTS' FIELD CLUB,

BY

C. CALLAWAY, M.A., D.Sc., F.G.S., *President.*

(Read at Gloucester, April 19th, 1904)

## PART I.—FORMAL RECORD.

During the past year eight new members have been elected, and we have lost five—three by resignation and two by death. Major A. K. Abbott died in March of the present year, and Dr W. D. Blyth, who joined in September, 1903, did not long survive his election. We have also to deplore the loss of a distinguished honorary member, Mr Robert Etheridge, who passed away in December last, at the ripe age of 84 years.

Robert Etheridge, though not a native of the county, was in the earlier part of his career closely connected with its scientific institutions. He served for seven years as Curator to the Museum of the Bristol Philosophical Society, and he was for over forty years an active member of this Club. In 1856, when on a visit to Lord Ducie, he was introduced to Sir Roderick Murchison, then Director-General of the Geological Survey, by whose influence he was appointed to the Survey as Assistant-Palæontologist, under J. W. Salter, in the Museum of Practical Geology. After 24 years' service in this department, he was transferred to the British Museum of Natural History, and held



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the post of Assistant-Keeper of Geology for ten years, when he retired under the official regulations. During the remaining 12 years of his life, he continued work, acting as Consulting Geologist to the Dover Coal Boring and as an expert upon water supply.

Mr Etheridge contributed to this Club the following papers:—'On the Rhætic or *Avicula contorta* Beds at Garden Cliff, Westbury-on-Severn, Gloucestershire' (1865); 'Section of the Rhætic Beds at Aust Cliff' (1866); 'On the Physical Structure of the Northern Part of the Bristol Coal Basin, chiefly having reference to the Iron Ores of the Tortworth Area' (1866); 'Supposed Permian Beds at Portskewet' (1868); 'Notes upon the Physical Structure of the Watchet Area, and the Relation of the Secondary Rocks to the Devonian Series of West Somerset' (1873). His memoir, 'On the Geological Position and Geographical Distribution of the Reptilian or Dolomitic Conglomerate of the Bristol Area,' which appeared in the Quarterly Journal of the Geological Society in 1870, was a valuable contribution to the geology of this district; and the same may be said of his paper in the Transactions of the Cardiff Naturalists' Society (1872) 'On the Rhætic Beds of Penarth and Lavernock.' His contributions to science outside our area were numerous and important. I may mention especially his paper 'On the Physical Structure of North Devon, and on the Palæontological Value of the Devonian Fossils,' his 'Stratigraphical Geology and Palæontology,' a new and revised edition of Phillips's Manual, and his palæontological appendices to Geological Survey Memoirs.

Mr Etheridge's abundant labours were frequently acknowledged by the approbation of the scientific world. He was elected a Fellow of the Geological Society in 1854, and held the Presidential office from 1880 to 1882. The Council of the Society awarded him the Woollaston

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Fund in 1871, and the Murchison Medal and Fund in 1880. He became a Fellow of the Royal Society of Edinburgh in 1855, and of the Royal Society of London in 1871, and served on the Council of the latter Society in 1884. Many learned societies at home and abroad elected him as Honorary or Corresponding Member.

Looking across the vista of half-a-century, I can recall the spare figure of Robert Etheridge when as a boy I traversed the Bristol Museum, and made my first acquaintance with the ammonite and the ichthyosaurus. I next met him at the Geological Society of London 25 years later, when I went up to read my first paper, for which Mr Etheridge acted as referee. I always found him most kindly and helpful, and this, I believe, was the experience of all his fellow workers.

The Club sustains a serious loss in the removal from the district of our Hon. Secretary, S. S. Buckman. His minute and extensive knowledge of the local geology, combined with his great acuteness and originality, made him a most stimulating contributor to our discussions. As Hon. Secretary, especially as editor of our Proceedings, his services have been of great value. His work at the British Museum drew him near to London, and ill-health prompted removal to a more bracing climate. A suggestion that the Club should show its appreciation in a substantial form was warmly adopted by the officers, and the result is the presentation to Mr Buckman of a cheque for fifty pounds. We all wish him improved health and successful work.

The first Field Meeting of the year was held in the May Hill district on Tuesday, May 19th. Starting from Longhope station, the members passed over the Silurian succession in descending order. The Wenlock Limestone received special attention. Near Huntley, the Longmyndian inlier was visited, and it was pointed out that the



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great Malvern fault passed between this mass and the Triassic sandstone which appeared close at hand to the east. In driving to Mitcheldean, the Silurian sub-divisions were crossed in reversed order, and a fine section of the overlying Old Red Sandstone was passed. Before lunch, a visit was paid to the church, where the rector, the Rev. L. Wilkinson, gave an interesting account of its history. The afternoon was occupied with a study of the Carboniferous rocks of Drybrook, with the subjacent transition beds, and the massive Old Red conglomerate which crops out on the road to Mitcheldean station.

On Tuesday, June 23rd, our second Field Meeting was held at Faringdon. The chief object of the visit was the study of the famous "Sponge-gravels" of the Lower Greensand. They were well seen at several localities, especially at the Little Coxwell pits, where Mr Davey, F.G.S., met the Club, and gave the members his assistance in naming the specimens which they collected in great variety. The Coralline Oolite was also visited, and the characteristic corals were obtained. At the church, the members were met by the Rev. A. F. Alston and Mr Luker, and a paper on the history of the structure, prepared by the latter, was read.

The Club met for the third Field Meeting at Worcester on Thursday, July 23rd. At Bromwich Hill the members investigated the gravel, in which worn shells of marine mollusca and mammalian remains had been found, as described by the President in his recent Annual Address. The examination was afterwards continued in the Worcester Museum, and the worn and fractured condition of the shells was compared with an unworn *Rhinoceros*-tooth from the same pit. In the Museum, the members studied the fine collection of fossil fish and saurians presented by the late Canon Winnington-Ingram in 1887, and their

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attention was drawn to the large granite boulders discovered near Worcester, and to the evidence they furnished of the southward movement of the glacial ice. At the luncheon, attention was called by the Rev. Walter Butt to the desirability of enclosing the long barrow at Belas Knap, and a committee, consisting of the President, Mr Butt and Mr Richardson was appointed to confer with the owner, Mr Rhodes. In the afternoon, visits were paid to the Cathedral and the Royal Porcelain Works.

The fourth Field Meeting was held at Painswick on Tuesday, September 22nd. The members first visited the gravels at Cainscross, under the guidance of Mr C. Upton, and then Mr A. J. Morton Ball was kind enough to invite them to inspect his fine collection of mammalian remains. At Painswick, the Club was met by Mr W. St Clair Baddeley, who guided them over the old Court House and the Church, giving them a most interesting history of the former. At the luncheon, the Rev. W. Butt reported that Mr Rhodes, the proprietor of Belas Knap, had most courteously entertained their suggestion, and had promised to construct a wire-fencing round the tumulus. In the afternoon, the members visited the lowermost beds of the Inferior Oolite, and passed over the succeeding formations to Kimsbury Camp, where the ancient earthworks were examined. Here Mr Baddeley delivered an admirable address, in which he argued with much cogency that the camp, commonly supposed to be Roman, was of British origin. The day closed most pleasantly with afternoon-tea on the lawn of Castle Hale, by the kind hospitality of Mr and Mrs Baddeley. The Club had reason to congratulate itself on the guidance of so skilled an antiquarian as Mr St Clair Baddeley.

The first half-day Excursion was made to Robins' Wood Hill on Saturday, June 6th. Previous to the ascent of the

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hill, the members visited the banks of the Severn, near the Rea brook, where Mr T. S. Ellis expounded his theory of river curves, and some discussion arose. On the hill, Mr Richardson gave an account of its structure, pointing out to the party that in ascending they passed from the Lower Lias over the Marlstone and a gentle slope formed by the clays of the Upper Lias to the *scissum*-beds, the basement of the Inferior Oolite, capping the hill. Evidence of the Cotteswold Sands was also observed.

On Saturday, July 11th, the second half-day Excursion was made to Churchdown. A sand-pit in the village was first examined. On the summit, Mr Richardson called attention to the Marlstone capped by a few feet of Upper Lias, the strata thus being more deeply denuded than in Robins' Wood Hill. Mr J. Sawyer was kind enough to show to the Club the most interesting points in the Church. A pleasant afternoon was concluded with tea at Barrow Hill, by the hospitable kindness of Mr and Mrs J. H. Jones.

At the Winter Meetings the following papers were read:—

British Land and Fresh-water Gastropods, by Major E. F. Becher.

Robert Emmett, by the Rev. A. R. Winnington-Ingram.

The Rhætic Rocks of Worcestershire, by L. Richardson, F.G.S.

Evidence of the Roman Occupation of Gloucester, by M. H. Medland, F.R.I.B.A.

Some Evidences of Ancient Occupation on Cleeve Hill, near Cheltenham, by J. W. Gray, F.G.S., and G. W. S. Brewer, F.G.S.

The People of India, by William Crooke, B.A., F.A.I.

The thanks of the Club are due to Mr Crooke and Mr Brewer for their contributions; to Mr G. H. Dutton, F.G.S., for exhibiting a selection from the Lucy-collection

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of Rock-specimens from the Superficial Deposits; to Mrs Price, of Tibberton Court, for defraying the cost of a block of a photograph of an Anticline in the Carboniferous Limestone to illustrate the Club's Proceedings; to Mr St Clair Baddeley for his admirable addresses at the Painswick field-meeting: and to Mr Luker for his interesting paper on Faringdon Church, read at the Faringdon field-meeting.

I have the pleasure of recording the following contributions to knowledge made by members of the Club outside our own Proceedings. Mr Buckman has contributed two papers to the *Quarterly Journal of the Geological Society*, dealing with "The Toarcian of Bredon Hill," and "Two Toarcian Ammonites." To the same periodical, Mr Richardson has contributed a like number of communications, entitled respectively "The Rhætic and Lower Lias of Sedbury Cliff, near Chepstow," and "On a Section at Cowley, near Cheltenham, and its Bearing upon the Interpretation of the Bajocian Denudation." He has also published a "Note on a Section of Great Oolite Beds at Condicote, near Stow-on-the-Wold," in the *Geological Magazine*. Mr T. S. Ellis has written on "River Curves round Alluvial Plains," in the same magazine. Mr John Sawyer has published an excellent book on "Cheltenham Parish Church: its Architecture and its History," illustrated with many plates; while Mr C. Upton has contributed another article to the second edition of the *Official Guide to the Stroud Valley*. Mr C. A. Witchell has published a most interesting book entitled "Nature's Story of the Year," in which acute observation is combined with picturesque description.

## PART II.—PRECAMBRIAN VOLCANOES.

In my last annual address, I drew your attention to a comparatively recent phase of the physical history of the Lower Severn valley, and attempted to demonstrate that its

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final form was due, not to marine action, but to subaerial forces, working by frost and running water. I now propose, by way of contrast, to picture to you the district in which we live as it was in those remote ages when no animal had yet trodden the solid land or fish swum in the waters; when, it may be, not even the humblest mollusc had come into being. Instead of the gentle Naiades of the air and stream, I shall invoke Pluto and his fiery myrmidons, and show you that, in Precambrian times, on the site of Malvern, and far away for hundreds of miles to the north and west, the subterranean energies of the globe were piling up volcanoes, and scattering showers of ashes over land and water. I take as my *point d'appui* the Uriconian rocks of Malvern.

Several rocky spurs project from the eastern base of the Herefordshire Beacon into the Severn Valley at Little Malvern, occupying an area of about one mile from north to south, and half-a-mile from east to west. They are built up of alternating bands of volcanic matter, the dominant type being acidic lavas, andesites and tuffs, a compact flinty variety of ash being very characteristic. The strike of the bedding is north and south, that is, parallel to the geographical strike of the Malvern range, and the dip at high angles to the east, with occasional reversal to the west. Associated with these strata are bands of dolerite; but whether they were flows of basic lava or later intrusions is not yet ascertained. The bulk of the above rocks are undoubtedly volcanic. They do not essentially differ from the products of recent volcanoes; but as they do not contain coarsely fragmental material, they were probably accumulated at a distance from any crater of eruption. They are a small relic of an extensive formation known as the Uriconian System. We may safely say that, in the Uriconian epoch, volcanoes were scattered over this area. Far below us at the present

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moment, buried beneath a vast thickness of Palæozoic and Secondary strata, there probably repose the denuded stumps of ancient cones, and the outspread products of their explosive activity.

These volcanic rocks are amongst the oldest in the British Isles, perhaps in the whole world. They are far older than the Cambrian epoch, for in Shropshire the lowest Cambrian strata rest upon them with a great discordance. But they are younger than the granitic and gneissic rocks of the Malvernian epoch, which near Shrewsbury yield rounded fragments to conglomerates interbedded with Uriconian tuffs and lavas. In the Gloucester area we have no evidence that in the Uriconian age any Malvernian rocks had been raised above the sea, so that we may conjecture, with some probability, that the Uriconian volcanoes were themselves the first land that emerged from the waves.

The Uriconian rocks of Malvern appear at the great fault that runs due north from the Bristol coalfield into Shropshire. They are not again seen in place on this line until we reach Lilleshall, near Newport (Salop); but the Permian strata of the Abberley Hills contain massive breccias made up of large angular fragments of typical Uriconian lava, and we may safely infer that in the Permian period Uriconian rocks were exposed in that area. Also at the southern end of the Malvern Hills, near Haffield and Bromesberrow, we have breccias commonly referred to the Permian, and these enclose fragments of Uriconian rocks.

Coming now to the Salopian area, we commence with the Uriconian of Lilleshall. It forms a rocky ridge of hard flinty volcanic mud, which 25 years ago struck me by its resemblance to the prevailing type at Little Malvern, and Professor Bonney confirmed this by the microscope. At this locality the Malvern fault intersects the great

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dislocation which runs from Lilleshall in a south-westerly direction into South Wales. At intervals on this latter line of fault appear narrow ridges of Archæan rocks, chiefly Uriconian. The most important of these masses are the Wrekin chain, near Wellington, and the Caer Caradoc group of hills at Church Stretton. These ridges are wedges of the Archæan floor thrust up through younger strata, and in some localities they further resemble the Malvern chain in that they are faulted against Cambrian and Silurian rocks on one side, and Triassic strata on the other.

The Uriconian rocks of Shropshire indicate active vulcanism. Lava-flows, often of great thickness, alternate with beds of ashes, which vary between coarse breccias and fine dust. But in this area we have clearer evidence of the conditions under which the rocks were formed. Some of the eruptions appear to have taken place on the land, for in Caer Caradoc the felsite contains geodes of quartz, which show a tendency to lie in parallel planes, as if they had replaced air-bubbles in a lava-flow. But a large proportion of the Shropshire Uriconian was deposited under water. The bits of felspar and pitchstone which make up a considerable proportion of the ash-beds are often water-worn, and rounded grains of quartz are commonly present. Still more emphatic evidence is furnished by frequent beds of conglomerate, interstratified with the finer bands of ash. They contain fragments up to six and eight inches in diameter, often as well rounded as the pebbles on a storm-beaten shore. The predominant materials are quartz, granite, several forms of gneiss, mica-schist, quartzite, felsite, pitchstone, and altered grits. The felsite and pitchstone are similar to Uriconian lavas, and are probably the result of contemporaneous denudation; but the others are derived from pre-existing land. Some of them are common Malvernian types; the

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remainder have not yet been recognised in the pre-Uriconian rocks of the district. We must then conclude that in Shropshire the Uriconian formation is largely of subaqueous origin. The area was presumably occupied by a shallow sea with scattered islands. Volcanoes ejected their contents over land and water. Waves beating on a rocky shore worked up beds of pebbles, and these became intercalated with finer material conveyed by currents or showered down from the sky. The volcanic cones were gradually worn away by denudation at a subsequent epoch. Submergence took place, and the sediments of the Cambrian were laid down. Later on, great dislocations split the Cambrian and later formations into cracks, and along these lines of fracture the wedges of Archæan rock were thrust up. The forces of the atmosphere have since worn them down to their present rounded forms.

To the west of Shropshire stretches a great expanse of Cambrian, Ordovician and Silurian strata; but Archæan masses re-emerge at the extreme south-west and the extreme north-west of Wales. St. Davids is classic as the region where Precambrian rocks other than the Fundamental Gneiss were first detected in this country. A central axis of granite is flanked on either side by volcanic strata, which Dr Hicks called Pebidian. They are, I believe, contemporaneous with the Uriconian, and as they were described at an earlier date, the term "Pebidian" has priority. However, as the evidence for Precambrian age is clearer in Shropshire than at St Davids, geologists have usually adopted my nomenclature for these rocks in the Midland counties. At St Davids the volcanic series consists predominantly of tuffs of greenish and reddish tints, varying in texture from coarse breccias, through many intermediate gradations, to fine silky schists, which are fine-grained ashes which have undergone metamorphism.

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Lapilli of felspar and felsite are abundant. Lavas are interbedded with the tuffs; but they are not so prominent as in Shropshire, and are sometimes of more basic composition.

The Uriconian again appears in north-western Caernarvonshire, forming two parallel bands, striking north-west and south-east, the more westerly extending along the eastern margin of the Menai Straits between Bangor and Caernarvon, the other emerging in the Llanberis district. The lower part of the series consists of massive flows of lava of the variety known as quartz-felsite, because the composition is so acidic that the silica is in excess, separating out as crystals and blebs of quartz. The upper Uriconian is fragmental. Professor Bonney describes felsitic grit, conglomerates interbedded with green grits, green breccias and slates. A large proportion of these rocks are volcanic *ejecta*. The rounding of fragments in the conglomerates and some of the grits indicates subaqueous deposition. At Bangor these beds are unconformably overlain by basal Cambrian strata, and near Llanberis the Lower Cambrian conglomerates rest upon the quartz-felsite, and contain rounded fragments of it. The Precambrian age of the volcanic group is thus distinctly proved.

Rocks of Precambrian age also occur in Anglesey, and some of these bear a close resemblance to slaty parts of the Uriconian at Bangor and in Shropshire. Volcanic material is found in them; but the proportion is not great, and the strata must have been laid down at a distance from any volcanic eruptions.

Returning to the Midland district, we find Precambrian volcanic rocks in Worcestershire, Warwickshire and Leicestershire. The Lickey quartzite, considered by the older geologists to be altered Silurian, has been determined by Professor Lapworth to be basal Cambrian, corresponding

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to the Lower Cambrian quartzite of the Wrekin. The base of this series shows included fragments of altered purple and green felspathic breccias and shales, and similar rocks have been detected in place below the quartzite at Barnt Green. In the Nuneaton district, certain strata mapped as Carboniferous turn out to be Cambrian, and at their base reappears the quartzite with derived volcanic fragments. The volcanic rocks, consisting of ashes and felsite, emerge from below the quartzite at Caldecote. The ash-beds are made up of angular bits of quartz and felspar, sometimes of the minuteness of dust. The eruptive rock is a quartz-felsite, but whether intrusive or a contemporaneous lava has not been determined.

The most important mass of Precambrian volcanic rocks in the eastern Midlands forms the picturesque region of Charnwood Forest. The local name "Charnian" has been given to the series; but it is generally admitted that they are the equivalent, at least partially, of the Uriconian. Their volcanic origin is most marked. Conspicuous varieties are green slates, sometimes so well cleaved as to be used for roofing. They are composed of comminuted felspar crystals, with earthy matter and some lapilli, and sometimes contain epidote or viridite, which gives the green colour. Some kinds are coarser, and these grade into breccias, containing angular fragments of slate, together with lapilli of andesite, trachyte, and other eruptive rocks.

The granite and syenite of Charnwood are well known for their commercial uses. They are regarded as intrusive in the volcanic series, and are therefore of later date.

I know of no other Uriconian masses in Great Britain; but in the north-west of Scotland evidence has been obtained of the former existence of a Precambrian volcanic formation which has entirely vanished. The red sandstone of Loch Torridon, considered by McCulloch to be Old Red,

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and subsequently identified by Murchison as Cambrian, is now proved by the Geological Survey to be Precambrian, and is called the Torridonian. It rests transgressively upon the Hebridean gneiss, with no formation intervening. Dr Hicks found in this newer Precambrian group included fragments of "greenish, purplish, and reddish slate, schist, jasper, etc., similar in many respects to those found in the Cambrian conglomerates of Wales," which he considered were derived from his Pebidian series. The Geological Survey later on described a conglomerate from the Torridonian, which contained, amongst other varieties, "well-rounded pebbles of slaggy porphyrite," a well-known volcanic rock. There is therefore good reason to believe that in the Scottish area there once existed a volcanic formation older than the Torridonian, and therefore of approximately the same age as the Uriconian. This is a remarkable example of the proof of a geological formation from the sole testimony of derived fragments in a younger group.

It would be unprofitable to attempt correlation between our English Uriconian and any external group of rocks. In several Irish localities, such as Howth Head, Wexford, and County Donegal, I have seen strata which bore a close resemblance to the slaty type of the Uriconian, and they were probably of Precambrian age. Volcanic rocks below the Cambrian are well-known in America. They occur in both the Lower and Upper Huronian, and later on they form enormous masses in the Keweenawan; but in the absence of fossil evidence we cannot affirm the exact contemporaneity of any one of these groups with the Uriconian. It is, however, interesting to note that in America, as in Britain, the periods preceding the Cambrian were marked by great and varied volcanic energy.

The doctrine of uniformitarianism receives striking confirmation from the Uriconian rocks. The lavas and

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tuffs ejected from the Precambrian craters are identical, both chemically and lithologically, with the products of modern eruptions. There are the same variations in composition, from the basic, in which lime, iron-oxide, and magnesia predominate, to the acidic, which yield a high percentage of silica, and in which the heavy bases are represented by soda and potash. Texture is equally variable, massive agglomerates containing huge volcanic bombs marking one extreme, and glassy lavas or dust-like tuffs the other. Some slight changes have affected even the least altered of the Uriconian rocks. Rhyolites (lava-flows) originally in the state of glass, are now devitrified, so that under the microscope they present a minutely crystalline structure. Fine-grained volcanic muds have become extremely hard, and ring under the hammer like flint. Both of these forms of alteration may be studied in the Uriconian rocks of Little Malvern. Basic lavas and ashes have often undergone partial decomposition, the hornblende or augite being changed to chlorite, a soft green mineral; and if the decomposition has been accompanied by pressure, a chlorite-schist may be produced. But in the British area the Uriconian rocks have not usually been transformed into crystalline schists, that change having much more frequently affected the Malvernian.

And now as to the life of the Uriconian epoch. Unfortunately we know of none. Yet the conditions were sometimes favourable to the preservation of organic remains. Deposits of volcanic ash laid down under water might have entombed the shells of molluscs or the tests of crustaceans, and retained them, or impressions of them, to all time. The alteration which the Uriconian rocks have undergone is often too slight to have obliterated such remains. We know that ancient volcanic strata are sometimes fossiliferous. A well-known example is the Bala

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ash on the summit of Snowdon. Even ashes erupted on the land may preserve organisms. But though no evidence of life has yet been detected in the Uriconian, this barrenness may be due rather to the perishability of the inhabitants of those ancient seas than to their scarcity. This subject was discussed in a paper which I read to the Club in 1899, and I must not now reopen it. I will content myself with pointing out that, in Precambrian times, it is unlikely that any conspicuous terrestrial forms of life had been evolved, so that the Uriconian landscape would have presented a weird spectacle to a visitor from another planet. No grass, or herb, or tree was in the ground, and there was no voice of living animal to mingle with the explosive thunders of the volcano, the pattering of the falling ashes, and the murmur of the changeless sea breaking upon the rocky and barren shore.

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# NOTE ON AN ANTICLINE IN THE CARBONIFEROUS LIMESTONE AT CHEPSTOW

BY

**L. RICHARDSON, F.G.S.**

*(See Frontispiece.)*

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For the excellent picture which forms the frontispiece of the present part of the *Proceedings*, the Club is indebted to the generosity of Mrs Price, of Tibberton Court. The little anticline depicted is seen on the right-hand side of the Chepstow and Gloucester road, where it ascends the hill after crossing the bridge over the River Wye. The picture is another instance, among many others, of the use which may be made of photography in geological research; since at a glance such reproductions from photographs present us with a truthful representation of a natural phenomenon, and record facts which might be inadvertently omitted from an ordinary sketch.

So important an accessory has photography now become to geology, that the British Association appointed a committee in 1889 to form a permanent public collection of photographs illustrating, as far as possible, the most important features of geological interest in the United Kingdom. "Up to the year 1895," wrote Dr H. Woodward, in a recent number of the *Geological Magazine* (1903), "twelve hundred photographs had



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been obtained, and it was deemed advisable that the collection should be placed in the Library of the Museum of Practical Geology, Jermyn Street, where it has since remained, and is available for reference to all those who take a real interest in or desire to make a proper use of it."

Reference to the Geological Survey Map will show that this little anticline is near a line of fault: a dislocation which is thereon represented to commence near Lancaut—the smallest parish in Gloucestershire—and to run thence southwards, for a distance of a mile-and-a-half, to the cliffs on the Wye a little to the east of the bridge at Chepstow. Possibly this faulting may have had some influence in rendering the anticlinal disposition of the strata more pronounced. There is little doubt that the time when the forces which came into renewed activity and caused pressure from approximately the east and west, so as to initiate this anticlinal flexure in the Carboniferous rocks, was at or near the close of the Carboniferous Period.

It is well known that over the greater part of England, and even in Europe and America, great earth-movements affected the Palæozoic rocks, bending the strata into folds, and causing anticlinal and synclinal flexures to alternate; "the folds," to quote Dr Callaway, "being sometimes shortened so as to resemble elongated domes or ellipsoidal basins." The genesis of this little anticline probably dates from this time.

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# THE RHÆTIC ROCKS OF WORCESTERSHIRE[1]

BY

**L. RICHARDSON, F.G.S.**

(Read December 8th, 1903.)

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## I.—Introduction.

For the study of the Rhætic Rocks[2] Worcestershire cannot be named as a county affording good opportunities. There are certain sections, however, which are important as showing the lithic and faunal characters of the particular beds exposed in this county.

In a former communication a résumé of the work accomplished in connection with the Rhætic Series in North-west Gloucestershire[3] was given, and on the same lines it is now purposed dealing with these rocks in Worcestershire. The portions of the county under consideration are represented on Sheets 44, 54, S.W., 54 N.W., and 54 S.E. of the Geological Survey; but it

1 Excepting certain detached portions in Warwickshire and Gloucestershire, and Berrow Hill. 2 A short account of the Rhætic Series is given in "The Victoria History of the County of Worcester," Vol. i. (1901), pp. 17-19. 3 Proc. Cotteswold Club, Vol. xiv. Part 2 (1903), pp. 127-174. See also Part 3 (1903), pp. 251-253.



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is only on the first of these that the Rhætic and Liassic strata have been differentiated. When the Rhætic deposits come to be mapped, without doubt they will be found to occupy a very considerable superficial extent. Since the dip of the beds is usually very slight, the writer has traversed the greater portion of the area occupied by the Lower Lias as shown on the Geological Survey Maps, on the possibility of finding the higher beds of the Upper Rhætic Stage somewhere exposed. For convenience of descriptive purposes the districts where these rocks occur may be described as an eastern and a western.

The noticeable northward trend of the two districts occupied by the Rhætic and Lower Lias (excepting the south-eastern portion of the eastern district in the neighbourhood of Cleeve Prior and North Littleton) is due to their preservation in synclinal flexures. Physiographically, this flexuring has produced some interesting phenomena—especially as regards the streams. In several places "through valleys" traverse the western escarpment of the western area: even where that escarpment is most marked, as near Crowle. The eastern limit of the same district, except for an extent of about two miles near Feckenham, is faulted; consequently, rivers flow across the line of junction of the Keuper and Liassic Series without giving rise to any phenomena which call for attention.

The main anticline, upon which the above-mentioned synclinal flexures are dependent, has a Malvernian trend, that is, north and south; and in the area under consideration, runs from a little east of Feckenham, southwards towards Cropthorne—the Charlton Abbots Valley being on the same line of elevation. The completeness of this anticlinal flexure, between a mile east of Feckenham, and three-quarters of a mile east-south-east of Netherton, is interrupted by a fault: the Lower-Lias strata having been brought into juxtaposition with the Upper Keuper

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Marls, and in places with the Upper Keuper Sandstone. Near Inkberrow this Upper Keuper Sandstone is of great assistance in determining accurately the position of the anticline. The Cracombe Hills cause an interruption to the valley which occupies the superficial extent of the Keuper Marls: the marls having been elevated by the movements causing the flexures referred to.

### II.—The Western District.

This district is represented on Sheets 44, 54 S.W., and 54 N.W. It extends from Turret Hill on the north (about three miles south-by-east of Bromsgrove) to a little under a mile south of Hill Croome Church on the south—a distance of 18 miles in a direct line. Its greatest breadth, from two-and-a-quarter miles north of Pirton, to three-quarters of a mile east of Throckmorton Church, is seven miles. In this county, as in North-west Gloucestershire, where unaffected by faults, the junction of the Keuper and Rhætic Series is usually marked by a low but very distinct escarpment. Approaching Crowle from Worcester—after traversing the undulating expanse caused by the Upper Keuper Marls, and the low elevation which indicates the presence of the Keuper Sandstone about half-a-mile west of Ravenshill—a fine view is obtained from the railway-bridge of the steep and in places almost precipitous ridge capped by the basement-beds of the Lower Rhætic. From the bold northern termination of this district, Turret Hill, a magnificent view is to be had of the surrounding country.

East of Hanbury the Rhætic area is being denuded by small tributaries of the Salwarp River, which seem to have opportunities of denuding the district about equal to the western tributary of the Bow Brook. Between Forest Hill and the rising ground at Hanbury, there is a

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conspicuous valley which is continued towards the south-east across the line of the Rhætic escarpment. Probably a river once rising considerably further to the north-west has excavated both the valley between Forest Hill and Hanbury, and also the prolongation running north of the farm known as "Great Lodge." Noticeable "through valleys" occur at Sale Green, and north-west of Broughton Hackett.

The section exposed in the road-cutting at Bourne Bank, near Defford, has been already described:[1] subsequent research at this locality has yielded no additional facts of interest.

In a "Postcript to the Memoir on the Occurrence of the 'Bristol Bone-bed' in the neighbourhood of Tewkesbury," Strickland brought forward evidence to show that the ossiferous development of the Bone-bed was passed through by a shaft sunk on Defford Common about half-a-mile to the east of the escarpment.[2] This shaft was sunk about the year 1772, and attained a depth of 175 feet. It was abandoned in the "Tea-green Marls," and consequently the horizon of the Bone-bed was passed through. Portions of this bed brought to the surface yielded to Strickland his "*Pullastra arenicola;*" and teeth, scales and coprolites of fish.

Between Croome Park and Norton the physical indications of the junction of the Keuper and Rhætic Series are very insignificant. A little under three-quarters of a mile to the north of Croome D'Abitot Church the junction of the two series may be observed, and the exposure is useful as it demonstrates the probable nature and the thickness of the deposit below the Bone-bed-equivalent at Bourne Bank.

1 Proc. Cotteswold Club, Vol. xiv., pp. 152, 153. 2 "Memoirs of H. E. Strickland," by Sir W. Jardine (1858), p. 160; Proc. Geol. Soc., Vol. iii. (1842), p. 732.

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I.—SECTION NEAR CROOME D'ABITOT.

| | | | ft. | ins. |
|---|---|---|---|---|
| Lower Rhætic | 15 | SANDSTONE. (**Bone-bed-equivalent**); fissile, yellowish-white (weathering brown), *Schizodus* (casts), *Modiola minima*, annelid-tracks and other markings ... ... ... (visible) | 1 | 1 |
| | 16 | SHALES, black, imperfectly laminated, clayey | 2 | 10 |
| | | Yellowish clayey deposit... ... ... ... | | 1 |
| Upper Keuper | I. | "Tea-green Marls." Pale, greenish-grey marls with a hard band of white marlstone near the top: the hard zone 7 inches thick ... ... | | |
| | II. | Red Marls, visible in fields below... ... ... | | |

About 400 yards east-by-south of the above exposure is an excellent section of beds of *pre-planorbis* date, and Mr H. B. Woodward, F.R.S., relegated the basement-beds that he saw here to the Rhætic Series.[1]

In the railway-cutting at the locality marked Abbot's Wood on the Geological Survey Map, Strickland noticed that "the beds of fissile sandstone at the base of the Lias are again exposed on the railway, being brought up by a fault."[2]

The railway-cutting on the Midland Direct Line to Birmingham at Norton breaches the escarpment, but the section once exposed is now overgrown. The "Tea-green Marls," however, are visible. The section presented was "exactly analagous to that at Dunhampstead, showing the same succession of lias limestone, clay, white thin-bedded sandstone, grey marl and red marl. The sandstone also contains the oval bivalve met with at Dunhampstead."[3]

In the farm-yard at Muckenhill a Rhætic sandstone (bed 17) is exposed, and in the field-track to the east the "Tea-green" and Red Marls of the Keuper are visible. The "Tea-green Marls" are again well exposed half-a-mile north-north-west of Wolverton. From Churchill Wood to Dunhampstead the escarpment is most marked. West of

1 Mem. Geol. Surv., "Jurassic Rocks of Britain," Vol. iii. (1893), "The Lias," p. 147.
2 Memoirs, p. 138; Proc. Geol. Soc., Vol. iii. (1843), p. 315. 3 Memoirs, p. 138.

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Churchill Wood the "Tea-green Marls" are to be seen with a band of compact, fissile, greyish-white, calcareous, micaceous (muscovite) sandstone above. On the south-west side of Thrift Wood, near the cow-shed, "Tea-green Marls" are visible; whilst a little to the west is much débris of Rhætic sandstone. Here the basement-beds only of the Lower Rhætic cap the steep escarpment, the red marls extending for some distance up the bank. Mr W. J. Harrison, F.G.S., makes mention of an exposure of "White Lias" *(pre-planorbis ?)* of some interest on the south side of Thrift Wood. "It [*i.e.* the 'White Lias'] is here a white earthy nodular limestone containing small quartz pebbles."[1] I was unable to find this exposure.

Mr G. E. Roberts, in his book on "The Rocks of Worcestershire," has given some information concerning "the steep [and] in places even precipitous, ridge, overlooking the vale of Worcester in the neighbourhood of Crowle." That author remarked that in this escarpment there is a stratum containing bivalve shells *("Pullastra arenicola")* and that he would expect to find traces of the Bone-bed and "Insect-limestone" *(Pseudomontis*-bed ?) or their equivalents. "At Wainlode Cliff and Aust Passage in Gloucestershire, which furnish complete series of the Upper Keuper beds, the bone-bed is close upon the band that contains the Pullastra; so that this shell, so plentiful in the Crowle escarpment, will indicate to us its whereabouts. Twenty-two feet above this is the place of the insect-bed: a thin band from three to five inches in depth, of hard blue limestone, in which delicate wings and wing cases *(elytra)* of various clear-winged insects *(Neuroptera)* and beetles *(Coleoptera)* are to be met with. If the height of the cliff is not equal to its production, I should look for it westward [eastward ?] between Clymer's Hill and Huddington."[2] In the village of

1 Proc. Dudley and Midland Geological and Scientific Soc. and Field Club, Vol. iii., No. 5 (December, 1877), p. 123. 2 (1860), pp. 183, 184.

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Crowle a thick deposit of sandstone containing one or more species of the genus *Schizodus* (in the form of casts) is exposed in the side of the road opposite the turning for the Church from the Worcester road; and again in the sides of the pond at Crowle Green.

### a.—The Crowle Section.

The best section of the Lower Rhætic in Worcestershire—of which, however, there is no mention, except that it was visited by a party of the Dudley and Midland Geological Society on May 29, 1877 [1]—is situated at the junction of the road from the house known as "Frisland" and that from Oddingley. It is easily accessible: not like that section seen in the railway-cutting at Dunhampstead, which is necessarily difficult of access. The beds in the

THE CROWLE SECTION.

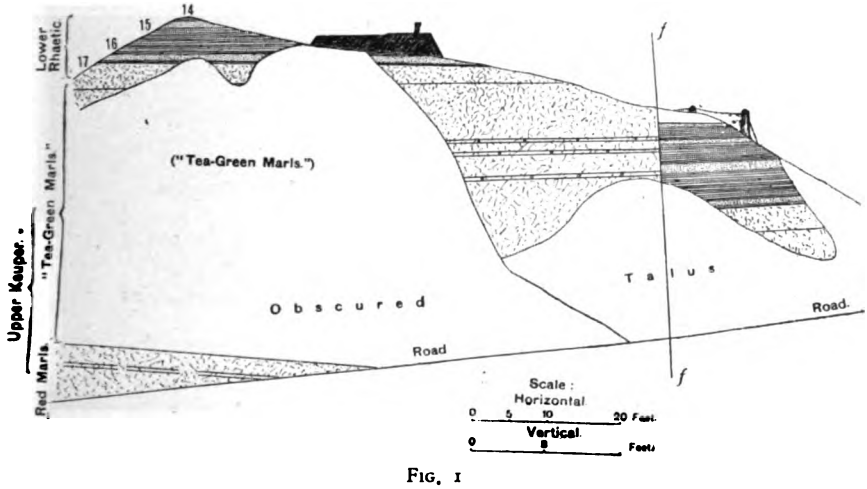


FIG. 1

Crowle section are affected by a fault (fig. 1) having a downthrow of about 14 feet. The "Tea-green Marls," which are well exposed, comprise creamy white marls,

1 Proceedings, Vol. iii., p. 106; but see also Geol. Mag., Dec. 4, Vol. x., 1903, p. 80.

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slightly green in places, and containing harder zones: the marl composing these harder zones having a most irregular fracture. At the base of the Rhætic is a conspicuous clayey deposit of a yellow colour.

II.—SECTION AT CROWLE, NEAR WORCESTER.

| | | | ft. | ins. |
|---|---|---|---|---|
| Lower Rhætic, or Zone of *Avicula contorta*. | 8 | SHALES, black ... ... ... ... ... | | |
| | 9 to 11 ? | SANDSTONE, yellowish white ... ... | | |
| | 12 | SHALES, brown, imperfectly laminated; uppermost 4 inches black ... ... ... ... | 1 | 2 |
| | 13 | SANDSTONE, several layers separated by shaly partings; *Gyrolepis Alberti*, teeth of *Gyrolepis ?* annelid-tracks, etc., ripple-marks, and a fish-vertebra ... ... ... ... ... | | 9 |
| | 14 | SHALES, black, numerous sandstone layers, uppermost 3 inches brown ... ... ... | 1 | 8 |
| | 15 | SANDSTONE. (**Bone-bed-equivalent**); yellowish-white, micaceous, fissile; *Schizodus* (casts), ripple-marks, annelid-tracks ... ... ... | 1 | 1 |
| | 16 | SHALES, black (weather grey), laminated, arenaceous towards the base ... ... ... | 2 | 11 |
| | 17 *a.* | SANDSTONE as 15; *Schizodus* (casts) somewhat abundant—especially in lowest layer ... | | 6-8 |
| | 17 *b.* | SANDSTONE layers with shaly partings ... | | 2-3 |
| | 17 *c.* | Yellow clayey deposit ... ... ... ... | | 1 |
| Upper Keuper | I. | "Tea-green Marls." Creamy white and slightly green marls, with hard zones in places, irregular fracture ... ... ... ... ... | 3 | 2 |
| | | Harder but similar marls ... ...(visible) | 1 | 8 |
| | | Creamy white, and slightly green marls, estimated at about ... ... ... ... | 26 | 2 |
| | II. | Red Marls with bluish zones and blotches ... | | |

About three inches of thin sandstone layers separated by shaly arenaceous partings divide the above deposit (C of 17) from a more massive bed of sandstone, in the bottom layer of which casts of a lamillibranch *(Schizodus)* are somewhat abundant. From the black shales which succeed no fossils were recorded, but they (in common with the rest of the beds in this section) have suffered much from atmospheric influences. These shales are

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capped by a massive bed of sandstone—the equivalent of the true Rhætic Bone-bed.

Now the changes this Bone-bed undergoes in its lithic structure in North-west Gloucestershire have been already demonstrated: how in the cliff section at Wainlode it passes from a thin pyritic bed, full of fish-scales and teeth, into a brown sandstone without fish-remains and about a foot thick;[1] and that as such it is visible in the road-cutting at Bushley, near Tewkesbury,[2] and at Bourne Bank, near Defford,[3] where it is two feet in thickness. In the early part of this paper[4] evidence was quoted to show that this thick deposit of sandstone occasionally acquires a "bone-bed" nature. In the section three-quarters of a mile north of Croome D'Abitot Church, the Bone-bed-equivalent is exposed 2 feet 11 inches above the "Tea-green Marls," but no sandstone-bed is present between the latter deposit and the shales. In the area, therefore, between that locality and Crowle, bed 17 has come in; and, as a matter of fact, we can state that it has come in between Muckenhill and Croome D'Abitot. To return to the Crowle section, 1 foot 8 inches above this Bone-bed-equivalent is a series of sandstone layers, separated by clayey partings, collectively nine inches in thickness, and it constitutes the most fossiliferous deposit in the section. It was in what the writer considers to be the equivalent bed near Deerhurst that the new species of *Heterastræa*, described by the late R. F. Tomes under the appropriate name of *H. rhætica* was obtained. About four inches of brown shales with thin sandstone layers succeed, and are capped by a deposit of black shales. Above again is débris of a sandstone-bed—possibly having a thickness of four inches.

1 Proc. Cotteswold Club, Vol. xiv., p. 133. 2 *Ibid.*, p. 150. 3 *Ibid.*, p. 153. 4 p. 22 of this paper. See also Quart. Journ. Geol. Soc., Vol. lx. (1904), p. 349.

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Below the "Tea-green Marls" can be seen the Red Marls, which become more in evidence as the hill is descended.

**b.—The Dunhampstead Section.**

The earliest account of this section is by H. E. Strickland,[1] who examined it when the original Birmingham and Gloucester Railway was made, about the year 1840. As Mr Harrison, however, observed in 1877, Strickland did not study it with that detail which was considered necessary, even in '77.

Strickland's record of it was as follows:—

| | | |
|---|---|---|
| "(a) Lias clay with contorted beds of lias limestone | | |
| (b) White micaceous sandstone, with numerous specimens of a smooth oval bivalve ..... ..... ..... | 2 | feet |
| (c) Lias clay ..... ..... ..... | 6 | „ |
| (d) Grey marl ..... ..... ..... | 35 | „ |
| (e) Red Marl ..... ..... ..... | | |

Bed b this author considered the equivalent of the Bone-bed, a conclusion with which the present writer is in agreement, but the thickness of the deposit called by Strickland "Lias clay," appears to be 4 feet 1 inch, not 6 feet. Mr Harrison put it at 3 feet 4 inches.

The Rev. P. R. Brodie, in his work "A History of the Fossil Insects in the Secondary Rocks of England," published in 1845, remarked that Strickland had found the "*Cypris*-bed" (*i.e.*, the *Estheria*-bed) and *Pecten*- and Bone-beds at this locality, but that the "Insect-limestone" was concealed, although it would be probably detected in its proper place.[2]

Mr G. E. Roberts observed, "at Dunhampstead. . . . . the ridge is cut through by the Gloucester Railway; and here the Bone-bed—a hard, thin stratum, full of the scales

1 Proc. Geol. Soc., Vol. iii. (1842), p. 314; see also pp. 586, 587; Memoirs, pp. 137, 138, 157, and Pls. 7 and 8; Trans. Geol. Soc., Ser. 2, Vol. vi., pp. 545-555. 2 p. 72.

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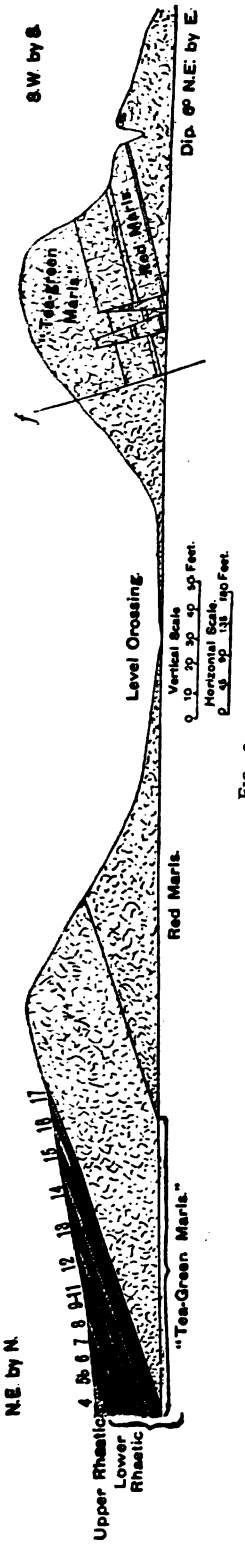


FIG. 2

and teeth of minute fishes—was detected by the late Mr Strickland." [1] It cannot be stated where this author obtained the evidence for observing that Strickland detected the Bone-bed, "a hard, thin stratum, full of the scales and teeth of minute fishes," at this locality. On a later page,[2] however, the results of Mr Roberts' investigations are shown to agree with those of other workers at the section, for whilst observing traces of the Bone-bed and "Insect-limestone," he was not rewarded by any notable discovery of their fossil contents.

The section was described in much greater detail by Mr Harrison in 1877, who remarked concerning the Bone-bed that "Although we searched as closely as time permitted, yet no trace of a true bone-bed was to be found in the Dunhampstead section. The sandstones Nos. 3 and 5 [15 and 17 of my section] each occupy horizons on which a bone-bed occurs in the Rhætic beds elsewhere." [3]

For permission to examine this interesting cutting, the writer is indebted to the Midland Railway Company, and he would express his thanks to the District Inspector, Mr King, for accompanying him during his investigations. Below the Rhætic beds is a considerable thickness of Upper Keuper Marl. Approaching the picturesque locality of Dunhampstead from the south along the line of rail, in the last cutting before reaching that at Dunhampstead proper, there is an instructive example of a fault, accompanied by a number of small step-faults (fig. 2): the lower

1 "The Rocks of Worcestershire" (1860), p. 183. 2 *Ibid.*, p. 204.
3 Proc. Dudley and Midland Geol. Soc., etc., Vol. iii., p. 123.

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two-thirds of the "Tea-green Marls" having been let down against the red marls.

III.—SECTION AT DUNHAMPSTEAD.

| | | ft. | ins. |
|---|---|---|---|
| Lower Rhætic | 4 & 5a? SHALES, sandy, clayey, light-coloured | 5 | 0[1] |
| | 5*b* LIMESTONE, hard, somewhat arenaceous, greyish-black; *Pecten valoniensis*, *Modiola* sp., *Pleurophorus*, *Avicula contorta*, *Gervillia*, *Cardium cloacinum*, fish-scale ... ... ... ... | | 1 |
| | 6 SHALES, brown ... ... ... ... ... | 2 | 0[1] |
| | 7 LIMESTONE nodules ... ... ... ... | | 10[1] |
| | 8 SHALES, black, clayey, pyritic (4 ft. less 1 ft. 5 in.) | 2 | 7[1] |
| | 9 to 11? SANDSTONE, brown, micaceous; *Modiola minima*, *Schizodus* ... ... ... ... | | 3 |
| | 12 SHALES, brown, clayey ... ... ... ... | 1 | 2 |
| | 13 SANDSTONE, yellowish (weathering brown), micaceous; *Modiola minima*, *Schizodus*, annelid-tracks, fish-scales *(Gyrolepis?)* ... ... | | 5 |
| | 14*a* SHALES, black, with sandstone layers containing *Schizodus*, *Avicula contorta* (4 inches) | 2 | 0 |
| | *b* SHALES, brownish (1 ft. 8 in.) ... ... | | |
| | 15 SANDSTONE. (**Bone-bed-equivalent**); fissile, yellowish-white, micaceous, ripple-marks, annelid-tracks; *Schizodus* (1 ft. 8 in. to 2 ft. 6 in.) ... | 2 | 1 |
| | 16 SHALES, blackish, thinly laminated in places, clayey in others, *Schizodus Ewaldi?* ... | 3 | 0 |
| | 17*a* SANDSTONE, greenish in places, usually yellowish-white, micaceous, ripple-marked, oblique lamination conspicuous; annelid-tracks, *Schizodus* (casts) .. ... ... ... ... | | 10 |
| | *b* Sandstone layers with shaly partings ... ... | | 3 |
| Upper Keuper | I. Greenish-grey and yellow marls: hard whitish zones near the top. "Tea-green Marls" ... | 35 | 0 |
| | II. Red Marls, somewhat laminated in places, variegated, with a few bluish-grey zones ... ... | 33 | 0 |

Entering the Dunhampstead cutting the red (Keuper) marls are seen, succeeded by the "Tea-green Marls," both deposits having a cuboidal fracture. The same deposits are exposed in the sides of a lane-cutting to the west. If the Dunhampstead section be compared with that at Crowle, the similarity will be at once noticed. There is, however, a slight thickening of the deposits here, and they are more fossiliferous. At both sections the beds have

1 Given on authority of Mr W. J. Harrison, F.G.S.

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suffered much from atmospheric influences, and it is necessary to excavate rather deeply before good examples of the organic contents can be procured. From bed 15 of the present record Mr Harrison obtained *Avicula contorta*; while of bed 13 the same author wrote, "in this no fossils were detected." The investigations of the present writer, however, yielded better results, and were such as might be expected, judging by the equivalent deposit at Crowle. Bed 14 yielded to Mr Harrison *Avicula contorta* and *Protocardium rhæticum*. At four feet above bed 14 Mr Harrison noticed a limestone-nodule, which he described as "an oval mass of limestone 2½ feet long by 10 inches in thickness. It was apparently *in situ*, for the shales wrapped round it in an undisturbed manner. This is rather a low horizon for the presence of septaria, but at Leicester bands of similar nodules occur in precisely the same position resting upon the shales." Now if the reader refers to pages 146 and 147 of Volume XIV. of the "Proceedings," he will notice that in the section of Coomb Hill, given on page 146, certain nodules, together with the one or two layers of hard shelly limestone upon which they rest, were considered the equivalents of beds 5 b to 7. In the Norton section the nodules and subjacent limestone were given as equivalent to bed 7, since there were present in that section beds equivalent to 5 b and 6. As will be gathered from the text on page 147, however, some uncertainty existed as to what bed the nodules at Coomb Hill represented. From the evidence available in Worcestershire the writer is inclined to think that he was correct in his correlation of the nodules and the subjacent limestone of the Norton section with bed 7; but those beds numbered 7 to 5 b at Coomb Hill must be described as bed 7—beds 5 b and 6 being absent. Thus he would consider the nodules of Mr Harrison's section bed 7; and the limestone bed two feet above, 5 b. At Woodnorton again we have

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beds 5 b and 6 apparently absent. These suggestions concerning the equivalents of beds 5 b, 6, and 7 in North-west Gloucestershire and Worcestershire do not, of course, lay claim to infallibility, since the portion of the Dunhampstead section under consideration is now obscured. However, there is little doubt that at Woodnorton we have a section at this horizon similar to that at Coomb Hill. It will be seen, then, that in Worcestershire, as in North-west Gloucestershire, "at this horizon [5 b, 6, and 7] the deposits are not nearly so constant as those immediately sub- and super-jacent." [1]

The limestone (5 b) is similar to a bed occupying the same stratigraphical position at Wainlode and Garden Cliffs. Of this stratum I did not detect any evidence in the cutting, but in a ploughed field to the west of the northern end of the canal-tunnel, numerous pieces were to be obtained from the surface, and yielded the fossils recorded in the section. Of the beds above 5 b, we have no details, excepting that "a considerable thickness of clayey beds ensues, and probably 30 or 40 feet of strata occur before we come to the lowest beds of the Lias." [2] This would mean that the deposits of the Upper Rhætic Stage were from 30 to 40 feet thick here. Although we know that the maximum thickness of the lower stage in Worcestershire obtains at this locality, and that it seems reasonable to suppose that the upper is similarly affected, still it is improbable that the latter attains the enormous—that is, for the Rhætic—thickness of 30 or 40 feet. In Strickland's description mention is made of Lias limestone containing Saurian-remains.[3] In a quarry at Saleway these "Saurian-beds" are exposed, and Mr Knight, Goods Manager at Dunhampstead, showed me the head of an *Ichthyosaurus* and a coral obtained from this section.

1 Proc. Cotteswold Club, Vol. xiv., p. 162. 2 Proc. Dudley and Midland Geol. Soc., Vol. iii., p. 123. 3 Memoirs, p. 137,

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IV.—SECTION AT SALEWAY.

| | | | ft. | ins. |
|---|---|---|---|---|
| | | Blue and yellowish marl, patches of red sand, and a few "Northern Drift" pebbles ... ... | 7 | 0 |
| Lower Lias (*pre-planorbis*) | 1 | Blue and yellowish marl ... ... ... ... | 2 | 0 |
| | 2 | Limestone, hard, blue; *Ostrea liassica* ... ... | | 3 |
| | 3 | Shales, brown; form a parting ... ... ... | | ½ |
| | 4 | Limestone, hard, blue; *Ostrea liassica* ... ... | | 5 |
| | 5 | Shales, brown; form a parting ... ... ... | | 1 |
| | 6 | Limestone, hard, blue ... ... ... ... | | 2 |
| | 7 | Shales, brown; form a parting ... ... ... | | ¼ |
| | 8 | Limestone, hard, blue ... ... ... ... | | 2 |
| | 9 | Shales, brown; form a parting ... ... ... | | ¼ |
| | 10 | Limestone, hard, blue; Saurian-remains (4 ins. to 8 ins.) ... ... ... ... ... | | 6 |
| | 11 | Shales, marly, clayey; Saurian-remains, a coral | | 5 |
| | 12 | Limestone, hard, blue. "Brick-bed" ... ... | | 3 |
| | 13 | Limestone, greyish-blue and somewhat argillaceous, fissile in places; crowded with *Ostrea liassica*, *Modiola minima*. "Bottom-bed." ... ... | | 2 |
| | 14 | "Clay" ... ... ... ... ... ... | | 8 |
| | 15 | "Limestone" ... ... ... ... ... | | 4 |
| | 16 | "Clay" ... ... ... ... ... ... | 2 | 0[1] |
| Upper Rhætic | 1 | "Limestone," *Pseudomonotis*-bed? ... ... | | 4 |

Fortunately, at the time of the writer's visit to this part of the county, the quarry was being worked, and he was able to obtain from the quarryman information concerning the four lowest deposits mentioned above. Bed 1 of the Rhætic is the lowest the quarryman knew of, and is very probably the equivalent of the *Pseudomonotis*-bed. Also, the writer was informed that all the limestone (that is, beds 2 to 15 inclusive) has been removed from the area between the railway-line at Dunhampstead and the row of apple-trees along the west side of the field in which the quarry is situated.

As already stated, it may be expected that the maximum thickness of the Upper Rhætic Stage obtains at Dunhampstead, but still it is probable that—bearing this consideration in remembrance—if we add the Saleway section to that at Woodnorton, and the latter to the Dunhampstead

1 This bed is now classed with the Lower Lias, in accordance with evidence recently obtained by the writer in South Wales.



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one, we shall have the complete sequence of deposits from the Upper Keuper to Lower Lias. This conclusion is followed out in the Table showing a "Generalized Section of the Maximum Development of the Rhætic Series in Worcestershire," and their relationship to the sub- and super-jacent stages (see page 44).

From near Primsland End, 1¼ miles south-west of Droitwich Road Station, to a little south of Broughton House—a distance of three miles—the (Upper Keuper) red marls are faulted against the Lower Lias. A pond about 100 yards south of Upper Goosehill Farm shows red marls; whilst along the ridge a little to the south again are traces of Lower Lias limestone with *Ostrea liassica*. Broughton Green is situated on high ground, the escarpment being very marked to the west. In the east bank of the road-cutting opposite Broughton House, the "Tea-green Marls" are exposed with bands of harder marl; whilst about 350 yards to the north-west, the base-ment-bed of the Rhætic (a sandstone) is seen resting upon similar marls in a pond-section. Along the escarp-ment the "Tea-green Marls" are frequently exposed; for example, 100 yards north-west of the pond-section referred to, and in an old pit—now utilized as a wood-yard—and roadsides a quarter of a mile south-east of Mere Hall. In the sides of the pond a little to the south-east of "Little Lodge," the Rhætic sandstone (17) is again visible, resting upon the "Tea-green Marls." A valley then interrupts the continuity of the escarpment. On the north side the "Tea-green Marls" are frequently in evidence, and there are numerous pieces of sandstone containing obscure casts of lamellibranchs, and covered with annelid-tracks and other markings. In the field south of, and in the cutting on the main-road from Droitwich, where it climbs the escarpment, the creamy-white marlstones of the "Tea-green Marls" much resemble at a distance pieces of

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"White Lias," such as occurs at Radstock, in Somerset. "Tea-green Marls" are again visible in the north bank of the road a little over a quarter of a mile west-south-west of "The Forest." Thence the escarpment is well marked, trending northwards to its bold termination, Turret Hill.

A little under a quarter of a mile north-west of "Gorse Hall," sandstone (17) resting upon "Tea-green Marls," is visible in a pond side, and the same bed caps Turret Hill. The north flank of this hill is very steep, but as we proceed south-eastwards, the declivity lessens, the Rhætic being faulted against the red marls of the Keuper. Proceeding south from the locality marked as Lane End, and taking the second turning to the left, limestones and clays are exposed in the banks of the stream just below the bridge. One bed of limestone, the first seen when proceeding down stream, *may be* the equivalent of the *Pseudomonotis*-bed, and the subjacent and superincumbent deposits are blue and yellow calcareous clays. A little further down stream the *Ostrea*-beds *(pre-planorbis)* are visible.

In the fields on the escarpment east of the locality marked as "Stoners" on the Geological Survey Map, are numerous pieces of sandstone (Rhætic), and in the field-track from this locality to Castle Hill the "Tea-green Marls" are exposed, and again about 700 yards north-west of Feckenham Church. Between Noers Green and Beanhall Mill the physical indications of the junction of the two series are not prominent; but at the latter locality, in the bank immediately to the north of the cottage, the "Tea-green Marls" are visible. From Morton Underhill to three-quarters of a mile east-south-east of Netherton, the Lower Lias is faulted against the Keuper. This fault is very accurately delineated on the Geological Survey Map, but unfortunately it was not possible to obtain the date of the newest Liassic deposit, which occurs in juxtaposition with



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the Lower Lias; and similar phenomena were noticed at Abberton. Here, as in the neighbourhood of Inkberrow, the results of "differential denudation" are well exemplified. At Abberton the Keuper Sandstone is exposed in the west bank of the lane, 250 yards west of the Church. It is, however, the change in the colour of the ground which indicates the position of the fault best.[1]

### III.—The Eastern District.

The eastern district has a maximum length, in a direct line, of about 10½ miles, and a breadth of about 7 miles. No appreciable feature marks the line of junction of the Keuper and Rhætic Series between Weethley and a point three-quarters of a mile south-west of South Littleton; whilst the junction between the latter locality and Harvington is faulted. In this district, as in the western, when the Rhætic rocks come to be mapped, they will be found to occupy a very considerable area, especially in the diversified neighbourhood of Rous Lench, Church Lench, and Hob (or Abbot's) Lench. The western limit of the district is marked by a steep escarpment, especially to the west of Sheriff's Lench, and owing partly to the position of the Avon, and partly to the Harvington-Littleton fault, an equally steep escarpment forms Cleeve and Marl Cliff Hills.

The escarpment marking the junction of the Rhætic and Keuper Series commences about a mile east of Netherton (where there is an exposure of "Tea-green Marls") and runs thence northwards to Cropthorne. A boring near Hasler (or Haselor) Farm proved 75 feet of Lower-Lias and Rhætic strata before the Keuper Marls were reached.[2] About a mile west-north-west of Bengeworth Station, the

1 There is an excellent exposure of red marl near Bishampton Field Farm.
2 Memoirs, p. 88; Mem. Geol. Survey, "The Jurassic Rocks of Britain," Vol. iii. (1893), p. 150.

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escarpment is breached by the Pershore Road, and a sandstone-bed (the Bone-bed-equivalent) is exposed.

V.—SECTION ON PERSHORE ROAD, NEAR BENGEWORTH STATION.

| | | | ft. | ins. |
|---|---|---|---|---|
| Lower Rhætic | 14 | SHALES, black ... ... ... ... ... | | |
| | 16 | SANDSTONE. (**Bone-bed-equivalent**); yellowish, fissile; various markings ... ... (visible) | | 9 |
| | 16 | SHALES, black ... ... ... ... ... | 1 | 1 |
| Upper Keuper | I. | Greenish-grey marls. "Tea-green Marls" ... | | |
| | II. | Red Marls (visible in fields below) ... ... | | |

Between this section and Charlton, in the ploughed fields along the summit of the escarpment, pieces of the *Estheria*-bed were found; also pieces of bed 7. A nodule similar to those at Coomb Hill, immediately above bed 7, was also observed. The pieces of the *Estheria*-bed obtained exhibited imperfect arborescent markings, and contained several *Estheriæ*. Bed 7 contained *Pecten valoniensis*, *Pleurophorus*, *Protocardium rhæticum*, and *Schizodus:* the nodule numerous well-preserved specimens of *Schizodus Ewaldi*. The "Tea-green Marls" are exposed in the sides of the lane leading southwards from Charlton—immediately after leaving the village.

### a.—The Woodnorton Section.

In the Duc d'Orléans' grounds at Woodnorton, over which Mr Wasley, the head keeper, kindly conducted me, there is a section of the Upper Rhætic deposits at the hill locally known as the "Blue Hill." A bridle-path here passes through a cutting under a public road. At the time of my visit (December, 1902,) the section was becoming rapidly obscured, but fortunately it was possible to obtain the thickness of the several deposits, and also to examine the limestone-beds.

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VI.—SECTION AT WOODNORTON, NEAR EVESHAM.

| | | | ft. | ins. |
|---|---|---|---|---|
| Lower Lias (*pre-planorbis*) | | LIMESTONE, bluish grey; *Ostrea liassica* ... ... | | 3 |
| | | CLAY, yellowish, marly ... ... ... ... | 2 | 7 |
| | | LIMESTONE, bluish-grey; shell fragments, *Ostrea liassica*, *Modiola minima*. In two layers ... | | 4 |
| | | SHALES, brown, thinly laminated ... ... | 2 | 0 |
| Upper Rhætic | 1 | LIMESTONE. *Pseudomonotis*-bed. Hard, bluish-black; *Modiola minima* ... ... ... ... | | 5 |
| | 2 | SHALES, grey and greenish-grey, laminated in places, usually non-laminated, marly ... | 5 | 4 |
| | 3 | LIMESTONE. *Estheria*-bed. Creamy-yellow, argillaceous; *Estheria minuta* var. *Brodieana*, *Lycopodites lanceolatus* ... ... ... ... | | 3·5 |
| | 4 | SHALES, grey and greenish-grey, and yellowish, thinly laminated in places, usually non-laminated, marly; shell-fragments ... ... ... | 14 | 6 |
| Lower Rhætic | 5*a* | SHALES, dark-coloured ... ... ... ... | | |
| | 7 | LIMESTONE nodules, containing *Schizodus Ewaldi*, resting upon a laminated limestone full of shell-fragments; *Pecten valoniensis*, *Schizodus Ewaldi*, *Protocardium rhæticum* and *Pleurophorus* ... | | 8 |
| | 8 | SHALES, black, laminated ... (visible) | | 6 |

This section is the only one of the Upper Rhætic deposits in the county, and is therefore of considerable importance. It demonstrates that the Upper Rhætic beds have increased in thickness. At Wainlode they are 12 feet 1 inch thick: here—deducting 3 feet from the lowest deposit of the upper stage, which would probably be found to belong to the Lower Rhætic, had it been possible to search for fossils—they have a thickness of 17 feet 7 inches. This difference in thickness is mainly due to the increase in bed 4. Beds 5 b and 6 were not observed: at Dunhampstead they have a collective thickness of 2 feet 1 inch; at Wainlode 11 inches (possibly a little more); and at Coomb Hill they are absent.

The *Estheria*-bed was seen as a creamy-yellow argillaceous limestone, somewhat laminated, and containing specimens of *Estheria* and plant-remains *(Lycopodites)*. The inclement condition of the weather at the time of the writer's visit prevented him from making as detailed an examination of these limestone-beds as he could have wished.

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About three-quarters of a mile west-south-west of Sheriff's Lench the "Tea-green Marls" are visible in the south side of the road from that hamlet to Hill; whilst a little over half-a-mile north-west of the former locality pieces of limestone identical with bed 7 at Wainlode Cliff were procured, and found to contain *Avicula contorta*, *Schizodus Ewaldi*, *Pecten valoniensis*, and much shell-débris. The same bed, similar as regards lithic structure and faunal contents, was observed (not *in situ*) a quarter of a mile west of Hob (or Abbot's) Lench. In the road-side, about a quarter of a mile north-west of the same village, the following section was recorded.

VII.—SECTION AT HOB (OR ABBOT'S) LENCH.

| | | | ft. | ins. |
|---|---|---|---|---|
| Lower Rhætic | 14 | SHALES, black, clayey ... ... ... ... | | |
| | 15 | SANDSTONE, (**Bone-bed-equivalent**); yellowish-white, greenish in places, fissile; *Schizodus*, various markings ... ... ... ... | 1 | 2 |
| | 16 | SHALES, black, clayey, imperfectly laminated (about) | 2 | 4 |
| Upper Keuper | I. | Marls, greenish- and bluish-grey. "Tea-green Marls ... ... ... ... ... ... | | |
| | II. | Red Marls (seen in fields below) ... ... ... | | |

This section is interesting as demonstrating (1) that bed 17 of the Crowle and Dunhampstead sections is absent; (2) that the shales below the Bone-bed are diminished in thickness; and (3) that the Bone-bed-equivalent is also less. This Bone-bed-equivalent may also be observed—though not so clearly—in the west bank of the road running north from the bridge over the brook in the village. In the Worcester Museum there is an excellent specimen of Bone-bed from this locality, and the writer is indebted to Mr William H. Edwards, the Curator, for kindly sending it to him for examination. The vertebrate-remains include *Acrodus minimus*, *Saurichthys acuminatus*, *Gyrolepis Alberti*, teeth of *Gyrolepis?* a piece of skin, and other remains too fragmentary to determine. The smaller piece of Bone-bed in the Worcester

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Museum (mounted with the other) is highly pyritic. The late R. F. Tomes informed the writer that these specimens were procured by himself and Mr Kershaw [1] from a well in the village, and that similar pieces—but much affected by atmospheric influences—were noticed on the ploughed fields near Church Lench. The finding of pieces of Bone-bed full of fish-remains is interesting, as showing that similar conditions obtain here as at Wainlode Cliff: a sandstone-bed without fish-remains passing into a pyritic stratum one inch thick, and full of such remains.

As showing the necessity for re-mapping this district according to the views now commonly accepted,[2] it may be mentioned that the Upper Keuper Marls extend from the so-represented inlier of Keuper deposits (half-a-mile north of Church Lench) to Morton Low: the ridge where traversed by the road between Church Lench and Morton Low being capped by "Tea-green Marls." Bed 7 was observed cropping out in the road south of Rough Hill Wood, and contained *Pecten valoniensis*, *Schizodus*, radioles of an echinoid, and much shell-débris.

Between Rough Hill Wood and Weethley, and again between the latter locality and three-quarters of a mile south-west of South Littleton, no exposures of the Rhætic beds were observed. Mr Tomes kindly conducted the writer to an exposure half-a-mile north-west of South Littleton which showed:

VIII.—SECTION NEAR SOUTH LITTLETON.

| | | | ft. | ins. |
|---|---|---|---|---|
| Lower Rhætic | 14 | SHALES, black ... ... ... ... ... | | |
| | 15 | SANDSTONE, (**Bone-bed-equivalent**); brownish; annelid-tracks, *Schizodus* (casts) ... (about) | | 2 |
| | 16 | SHALES, black, laminated ... (estimated at) | 1 | 6 |
| Upper Keuper | I. | "Tea-green Marls" | | |
| | II. | Red Marls | | |

1 See W. J. Harrison, "Geology of the Counties of England and North and South Wales (1882), p. 296. 2 Grouping the "Tea-green Marls" with the Keuper.

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About half-a-mile to the north of this exposure, the "Tea-green Marls" are visible in the east bank of the road ascending the hill, and again are well exposed in the west side of the road above Cleeve Mill.

Mr Tomes informed the writer that in the digging out of a pond opposite his house (about 100 yards north-east of the Church, South Littleton) the black shales of the Lower Rhætic were excavated. This means that the total thickness of the Upper Rhætic was passed through; the *Estheria*-bed occurring according to Mr Tomes about eight feet below the *Ostrea*-beds. The *Estheria*-bed is frequently exposed in deep drains and other excavations in this neighbourhood. Mr Tomes also informed the writer that the black shales (Lower Rhætic) are very thin around South Littleton—a fact the writer had expected.

Finally, on the borders of Worcestershire and Warwickshire, in the picturesque Marl Cliff, the junction of the Keuper and Rhætic Series is exhibited, and in considering bed 15 the equivalent of the true Rhætic Bone-bed the writer had the support of Mr Tomes.

IX.—SECTION AT MARL CLIFF.

| | | | ft. | ins. |
|---|---|---|---|---|
| Lower Rhætic | 14 | SHALES, black ... ... ... ... ... | | |
| | 15 | SANDSTONE, (**Bone-bed-equivalent**); yellowish (weathers brown); a few fish-scales (*Gyrolepis*) (about) | | 1 |
| | 16 | SHALES, black, laminated, clayey ... ... | 2 | 0 |
| Upper Keuper | I. | "Tea-green Marls" ... ... ...(about) | 24 | 6 |
| | II. | Red Marls ... ... ... ... ... ... | | |

## IV.—Conclusion.

Although there are but comparatively few good sections of the Rhætic Series in Worcestershire, the results obtained from an investigation of these rocks are important for several reasons.

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Generally speaking, the component deposits of the lower stage are fairly persistent, but there is evidence to show that at the horizon at which they are not so constant is at the top of this stage—beds 5 a, 5 b, 6 and 7.

In tracing the Bone-bed into Worcestershire, it has been shown that the massive sandstone-bed at Bourne Bank is its equivalent. This bed, near Croome D'Abitot, rests upon 2 feet 11 inches of shale, and the latter deposit upon the "Tea-green Marls." At Dunhampstead, however, between the Bone-bed-equivalent and the "Tea-green Marls" is a deposit 4 feet 1 inch thick, while the maximum thickness of the Bone-bed-equivalent is 2 feet 6 inches. The point, however, to notice, is the presence of a sandstone-bed resting upon the Keuper Marls—bed 17. From a study of the sections, it is obvious that the maximum thickness of the Lower Rhætic Stage, and most probably of the upper also, obtains here. But from Dunhampstead to Wainlode Cliff, the Bone-bed and the subjacent Rhætic deposit becomes thinner, and the same phenomenon is observable if the beds be traced eastwards, for at Marl Cliff the Bone-bed is but one inch thick, and is separated from the "Tea-green Marls" by two feet of shale.

The only section of the Upper Rhætic at Woodnorton shows that the lithic structure of the component beds is fairly persistent, but that—as compared with Wainlode Cliff—their total thickness has increased. The *Estheria*-bed, as in North-west Gloucestershire, affords a sure datum-line for correlation purposes.

### V.—Note on the Generalized Section.

In order to facilitate the correlation of the beds visible in the sections in Worcestershire with those in North-west Gloucestershire and at Sedbury Cliff, near Chepstow,[1] the

1 Quart. Journ. Geol. Soc., Vol. lix. (1903), p. 390.

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writer has employed the same numbers for what he considers the equivalent deposits. In his notes "On Two Sections of the Rhætic Rocks in Worcestershire," [1] however, it was found undesirable to use the same sequence of numbers. The object of that communication was merely to record two sections, and as these presented an almost complete sequence, certain details of beds not therein visible were given on the evidence of the Dunhampstead section. Therefore the aim of this note is to point out that, even if these three records be read in their proper order, they will not afford a generalized section of the *maximum* development of the Rhætic Series in Worcestershire, as the beds 5 b and 6 are wanting at Woodnorton.

1 Geol. Mag., Dec. 4, Vol. x. (1903), p. 80.

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# TABLE I.

## GENERALIZED SECTION OF THE MAXIMUM DEVELOPMENT OF THE RHÆTIC SERIES IN WORCESTERSHIRE.

| | | | ft. | ins. | |
|---|---|---|---|---|---|
| Lower Lias (Saleway) | | Alternating deposits of limestone, shale and marl ... | 7 | 10 | *Ostrea liassica*, *Modiola minima*, Saurian-remains and a coral. |
| | | SHALES, brown ... ... | 2 | 0 | |
| Rhætic Series — Upper Rhætic (Woodnorton) | 1 | PSEUDOMONOTIS-bed ... | | 5 | *Modiola minima.* |
| | 2 | SHALES, grey, greenish-grey | 5 | 4 | |
| | 3 | ESTHERIA-bed. (3 inches to 5 inches... ... ... | | 4 | *Estheria minuta*, var. *Brodieana*, *Lycopodites lanceolatus.* |
| | 4 | SHALES, grey, greenish-grey | 11 | 6 | |
| Rhætic Series — Lower Rhætic (Dunhampstead) | 5a | SHALES, dark-coloured ... | 3 | 0 | *Pecten valoniensis*, *Modiola* sp., *Pleurophorus*, *Avicula contorta*, *Gervillia*, *Cardium cloacinum*, fish-scale. |
| | 5b | LIMESTONE, somewhat arenaceous ... ... ... | | 1 | |
| | 6 | SHALES, brown ... ... | 2 | 0 | |
| | 7 | LIMESTONE nodules, in certain sections resting upon a laminated shelly limestone. Nodules alone at Dunhampstead, 10 inches: when nodules and limestone are present in juxtaposition, beds 5 b and 6 are absent... ... ... | | 10 | Nodules contain *Schizodus Ewaldi*, laminated limestone, *Pecten valoniensis*, *Schizodus Ewaldi*, *Protocardium rhæticum*, and *Pleurophorus.* |
| | 8 | SHALES, black, clayey ... | 2 | 7 | |
| | 9 to 11? | SANDSTONE, brown, micaceous ... ... ... | | 3 | *Modiola minima*, *Schizodus.* |
| | 12 | SHALES, brown, clayey ... | 1 | 2 | |
| | 13 | SANDSTONE, yellowish (weathering brown) micaceous ... ... | | 5 | *Modiola minima*, *Schizodus*, annelid-tracks, fish-scales (*Gyrolepis ?*). |
| | 14 | SHALES, a. black, with sandstone layers 4 inches. b. brownish, 1 foot 8 inches | 2 | 0 | *Schizodus*, *Avicula contorta.* |
| | 15 | SANDSTONE, (**Bone-bed-equivalent**); yellowish-white, micaceous, 1 foot 8 inches to 2 feet 6 inches | 2 | 1 | *Schizodus.* |
| | 16 | SHALES, black ... ... | 3 | 0 | *Schizodus Ewaldi.* |
| | 17 | SANDSTONE... ... ... | 1 | 1 | *Schizodus.* |
| Keuper Series — Upper Keuper | I. | "Tea-green Marls" (Dunhampstead) ... ... | 35 | 0 | |
| | II. | Red Marls, variegated with a few bluish zones ... | 215 | 0 | |
| | III. | Sandstone (Pendock) ... | 20 | 0 | *Estheria minuta*, fragments of plants, etc., fish-remains. |
| | IV. | Red Marls (Rainbow Hill, Worcester) ... ... | 1000 | 0 | |
| Keuper Series — Lower Keuper | | Sandstone, breccia, and conglomerate ... ... ... | 316 | 0 | |
| Bunter | | Sandstone (Bromesberrow), conglomerate (Wolverley)[1] ... | 800 | 0 | |

1 *Vide* "Monogr. Fossil Estheriæ," Pal. Soc., (1862), pp. 62, 63.

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# ON SOME FURTHER EVIDENCE

OF

# THE ROMAN OCCUPATION OF GLOUCESTER

BY

M. H. MEDLAND, F.R.I.B.A.

(Read February 9th, 1904)

Whilst excavations were being made, during the summer of 1903, for foundations for the front wall of new offices for the Gloucester Railway-Carriage and Wagon Company, in Bristol Road, a bed of stones (of various descriptions, embedded in clay, and of an average thickness of two feet) was found at a depth of six feet from the pavement level, and extended the whole length of the building (some 133 feet): the bottom of the deposit being eight feet below the level of the pavement.

The bed of stones, which extended westward from the street some twelve feet, was covered with a bed of compact yellow clay, three feet thick, which showed no apparent sign of interference by human agency.

In consequence of the great variety of sub-angular stones that were found, and the worn and scratched condition of many of them, together with the condition under which they were found, namely, under a bed of clay three feet thick, it was at first surmised that the stones had been deposited by the stranding of an iceberg or ice-floe. The subsequent discovery, however, of fragments of thin brick and tile among the stones, and pottery and horse-shoes

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in the clay, led to the conclusion that the stones must have been deposited by human agency.

The following questions naturally arose, namely :—

When and why were the stones placed here?

How could such an accumulation of clay have been deposited over them?

It seems probable that the stones were placed there during or subsequent to the Roman occupation of Gloucester, some 15 or 16 centuries ago, as evidenced by the presence of scraps of Roman bricks, tiles, and horse-shoes. The scraps of roofing tiles are of precisely the same section as some found on the site of the Wilts and Dorset Bank at the Cross, Gloucester, during excavations in 1893, at a depth of some ten or twelve feet from the present pavement level. The last-mentioned fragments were found associated with charred wood, and were evidently from an important Roman building, possibly a Basilica or Temple occupying a prominent position in the Forum of Glevum. The sections of the edges of the bottom and cover-tiles display considerable ingenuity in order to prevent capillary attraction, and thus to keep the flowing water in its required channel.

The reason for placing the stones here may be found in the circumstance that the locality lies very low, and immediately adjacent to the Sudbrook, a tributary of the Severn. The locality was probably a marsh, with the Sudbrook running through it, and, for the convenience of traffic between Glevum, Bath, and the South, required a hard bed to form a ford. The deposit was evidently made under water, from the fact that the stones had not been laid in any sort of order, either as regards size or level, but had apparently been thrown in without care in their disposition.

The stones were of varied sizes, and mixed indiscriminately with dark clay, which evidently formed the bottom of the marsh.

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Evidence of a swiftly running stream, consisting of sharp sand and pebbles of various formations, was found in the deposit of stones

Lastly, how could such an accumulation of clay or mud have been deposited on the stones?

The answer to this question may be thus stated. The Gloucester and Berkeley Canal, which runs some 400 yards to the west of the Bristol Road, was commenced, at the Gloucester end, at the close of the 18th century. It appears evident that the spoil from the excavation was spread over the adjacent low-lying land, extending from the Canal to the Bristol Road. The uppermost or yellow clay would be moved first, and be wheeled or carted to the farthest destination. This would account for the uniformly coloured (yellow) clay found over the deposit of stones, and also for the variously coloured clays (yellow, blue, and neutral) found to the west of the stone deposit.

A striking bit of evidence that this deposit of yellow clay is comparatively modern is found in the fact that a round lead bullet was discovered near the bottom of the clay-bed.

Tradition says that the chapel and burial-ground of Llanthony Priory were destroyed to make way for the Canal. Evidence of this is, I think, shown by a brass pin that was found at the bottom of the yellow clay. It is of mediæval design, and of ecclesiastical character—a cross within a circle. It may have fastened some part of the clothing of one of the monks of Llanthony.

Hall and Pinnell's map of Gloucester, published in 1780 (a few years only before the commencement of the Gloucester and Berkeley Canal) shews an island existing between the Bristol Road and Llanthony Priory, on the east end of which now partly stands the Gloucester Wagon-Works. The eastern end of the island is bounded by the Bristol Road.

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The watercourse on the north side of the island is now culverted, and passes under the Railway Inn, on the north side of the Wagon-Works; whilst the channel, surmised to have been formed as a feeder to the Canal, runs through the Midland Railway yard, lying to the north of the Railway Inn and the Wagon-Works.

A few remarks on the stones, etc., that were found may be of interest.

The stones included those of Old Red Sandstone, Lias limestone, Inferior-Oolite limestone, and pebbles of quartz and flint. Many of the stones, especially those of Lias limestone, had probably been in use as road "sets": their faces being rubbed smooth, and in some cases grooved, where wheeled traffic had been concentrated.

The horse-shoes are apparently of different dates; those thickly encrusted through oxidation being possibly Roman or Mediæval. There is a somewhat similar one in the Gloucester Museum, described as Mediæval.

The other horse-shoes may be of the 16th or 17th century. They are very wide and flat.

A curious implement, possibly a meat-hook from the Priory, was also found in the clay.

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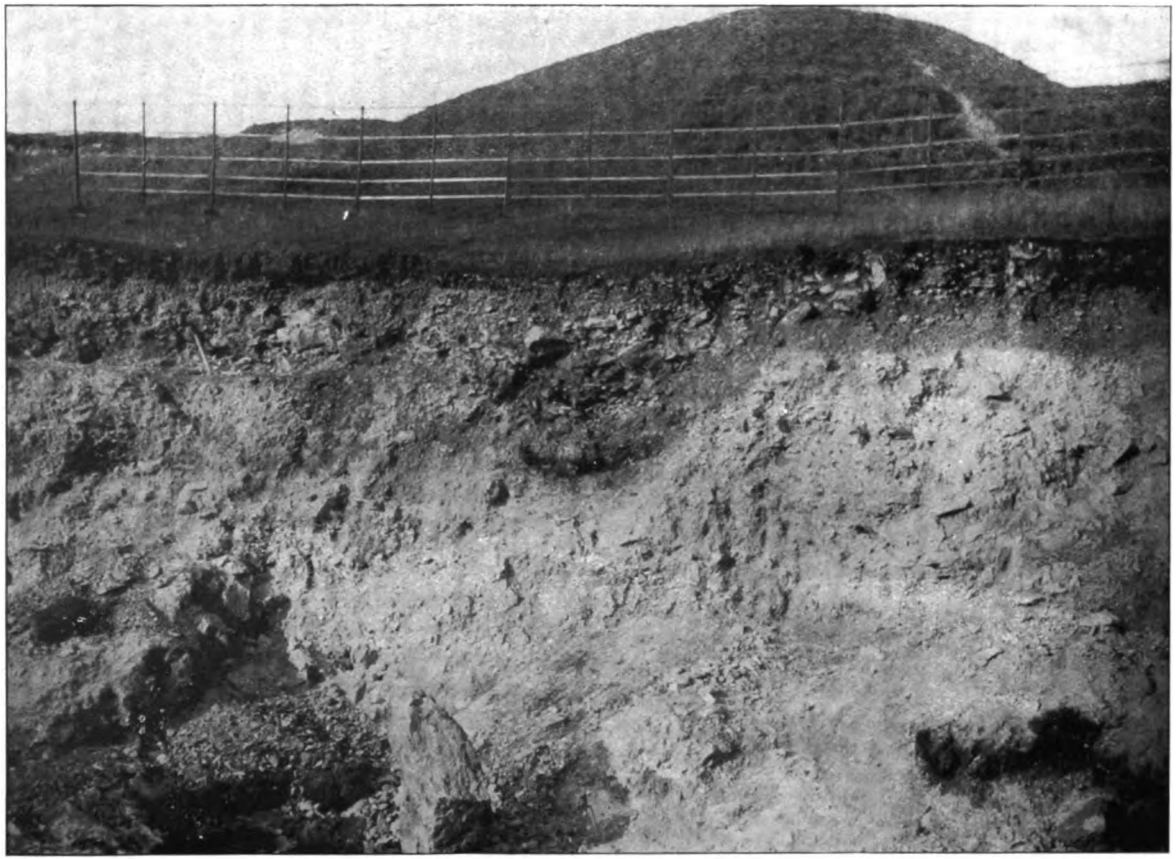

KING'S BEECHES GRAVEL QUARRY, CLEEVE HILL, SHOWING PIT
(The pit lies in the centre of the view, and can be distinguished by dark band.)

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# EVIDENCES OF ANCIENT OCCUPATION

ON

# CLEEVE HILL

BY

J. W. GRAY, F.G.S. and G. W. S. BREWER, F.G.S.

## APPENDIX

BY

M. A. C. HINTON and A. S. KENNARD.

(Read February 9th, 1904.)

---

On Cleeve Hill, at a height of about 800 feet O.D., and lying under the western side of Ben's Tump, is a small platform, running north and south, and about 90 yards in length by 20 yards in width. The southern part of this platform is bounded on the one hand by the road which passes into the Rising Sun Lane and Gambles Lane; and on the other by a track leading directly to the top of Ben's Tump, where it divides—one branch leading to Wickfield Lane, the other to Prestbury Hill Gate and the West Downs by way of Cleeve Cloud (see map, fig. 2).

That part of the platform near the roadway referred to has been quarried for gravel for a few years; but it is only during the last two that it has been regularly worked.



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The section (fig. 1) will give some idea of the material above the gravel.

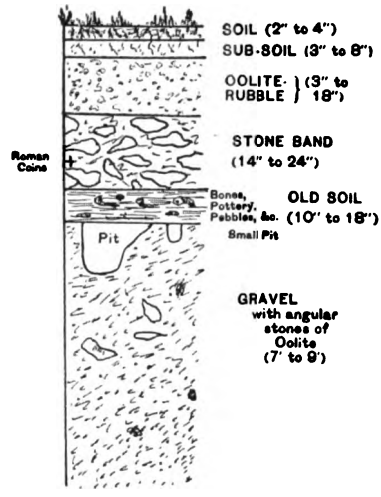
SOIL (2" to 4")
SUB-SOIL (3" to 8")
OOLITE-RUBBLE (3" to 18")
STONE BAND (14" to 24")
Roman Coins
Bones, Pottery, Pebbles, &c.
OLD SOIL (10" to 18")
Small Pit
Pit
GRAVEL with angular stones of Oolite (7' to 9')

Fig. 1.—SECTION OF KING'S BEECHES GRAVEL QUARRY.

1. Soil and subsoil.
2. Fine oolite-débris.
3. Band of angular fragments of oolite.
4. Old soil, in which bones, pottery, etc., occur. This deposit is very hard and compact, as if well trodden. The stones embedded in the surface are smooth, as though from much use, and resemble those from a well-worn pathway. They are quite distinct from the overlying stones.
5. Gravel, with large and small blocks of oolite.

The gravel-pit faces west, and is about twenty-five yards in length by four yards deep. The thickness of the deposit removed to uncover the gravel varies from three to five feet in depth, and is undoubtedly the continuation of a quarry "tip" which lies behind the platform. The removal of the gravel has exposed a number of ancient pits, which appear to consist of three types.

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TYPE I. (a.) Near the centre of the quarry (see Plate II.,) was found a pit, which commenced at the surface of the gravel, where it measured nine feet long, north and south, by three feet six inches wide. Half-way down the diameter of this pit was reduced to three feet six inches, leaving a projection on one side, which was continued to the bottom. The total depth of the pit was three feet four inches. The sides had no artificial lining. The sequence of the different layers in the pit was as follows:—(1) Dirt-band with small teeth and bones. (2) Water-rolled stone-band, with teeth, bones, etc. (3) Fine gravelly band, with small stones and a few bones. (4) Black band. The last-named deposit, which lay in the bottom of the pit, was composed almost entirely of carbonised wood, ash, and very fine soil. Throughout this layer, which was eleven inches in thickness, bones and fragments of pottery were found. The pit probably had been abandoned, and filled up by the action of the weather and infiltration. Neither the sides nor bottom showed any traces of the frequent use of a fire, such as reddened stones or soot.

(b) Another pit of the same type was found as the gravel was worked back. It was smaller than the preceding, of a circular shape, with a diameter of two feet six inches and a depth in the gravel of two feet eight inches. In this pit we found the following sequence:—(1) Dirt-band. (2) Yellow loamy material with gravel. (3) Black band, comprising carbonised wood, ash, etc., in which were found a few bones and a fragment of pottery.

(c) From the quarryman and others we heard of a pit which was found before our attention was directed to the quarry. It was described as having been about ten feet long, east and west, and four or five feet in width, with a depth of about four feet in the gravel. In this pit was found a boar's tusk, a jaw, and other bones of pig, and some



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pottery, and from the end of it one of us obtained a block of stone, with a basin-cavity in one end, several quartzite grinders, and pieces of worked sandstone. As far as we can ascertain, there was no burnt material in the bottom of this pit.

TYPE II. (a.) Scattered around these pits were a number of small ones—twenty of which have been observed. These were excavated only to a depth of about one foot six inches in the gravel, and were one foot in diameter. Some of the smaller of these pits were half-full of clay, which must have been placed there, for the nearest exposure of that deposit *in situ* is at least fifty yards distant.

(b) At various stages of the quarrying other pits were exposed, varying from eighteen inches to two feet six inches in diameter, and from two to three feet in depth. The contents vary, but *all* contained burnt wood and bones, clay, pottery, and a greasy material like adipocere. In some cases the pits were full of these materials, in others the upper part consisted of gravel.

TYPE III. These were shallow pits or depressions into which débris had been washed. They were about six or seven feet in diameter, and their greatest depth was two feet. No less than six or seven of these pits have been noted, and the measurements in each case were somewhat alike. No carbonised wood was found in the bottom, and the pits had no artificial lining.

Many interesting objects have been found, those of stone largely preponderating.

STONE. (1) A large block of oolite with a basin-shaped cavity, which, however, was not worn evenly all round. The size of the stone is as follows :—Height one foot six inches, width twelve inches, and length ten inches. The basin is three inches deep, and has a diameter of six and a half inches. This stone may have been used either for separating the husks from barley by beating; or for

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grinding corn; or for working into a paste, sand, small stones and clay for pottery; or pounding acorns for food.

(2) A flat round piece of oolite, with a diameter of two inches and thickness of half an inch. Near this were found two similar stones, and a fragment of another. These, however, were not so carefully worked. It has been suggested that they were used for playing games. Lord Avebury says—"The Feegeeans . . . . are fond of games . . . of throwing stones or fruit at a mark." [1] And again, in speaking of the vessels made and used by this people,—"The pottery was all made by the women. Their tools were very simple, consisting of a small flat round stone to fashion the inside." Thus the Cleeve Hill examples may have been put to a similar use.

(3) Several quartzite grinders were found. Two of them were of an unusual type, inasmuch as they had been used only on the ends.

Other quartzite pebbles show signs of use, as if for breaking bones for marrow. Some of the pebbles found were possibly sling-stones. The pebbles are of the liver-coloured variety, and are foreign to Cleeve Hill.

(4) A small triangular-shaped piece of Stonesfield Slate with rounded edges, one side concave, one convex, and one straight, would have made an excellent tool in the hands of a potter, since it would form any of the curves of the pieces of pottery found at the King's Beeches.

(5) A piece of fine grained limestone with a concave end, possibly used for finishing the rims of vessels.

(6) Three small pieces of sandstone, probably parts of one implement, which may have been used for smoothing and finishing earthenware vessels, or for preparing skins.

(7) The remaining stones are of a miscellaneous character, and call for little notice. These included several pieces of stone which had been used for grinding, polishing, or sharpening tools. One is a piece of fine-grained

1 "Prehistoric Times," p. 454.

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red sandstone. Three flints only were found, a scraper, a portion of a knife, and one with a notch, which probably was used for scraping bone needles, etc. A point, used for boring, is broken off. Several hearthstones were from time to time met with in the old soil. These were large stones, on which fires had been placed, or which had been placed round a fire.

THE ANIMAL REMAINS, of which a large number were found, consist of bones (including man) and mollusca. These are dealt with in the Appendix. On a fragment of bone, ground to a point, Mr A. S. Kennard expresses the following opinion: "It is very interesting, and certainly rude, and totally unlike anything that I have seen."

POTTERY. Fragments of pottery were plentiful throughout the old soil—for the most part, however, in very small pieces. It is all distinguished as being coarse and badly fired. Some have the appearance of being wheel-turned, but this is doubtful, especially if the tools we have above described were used. There is practically no attempt at decoration, and the vessels were probably made for domestic use. There is a total absence of Roman and Romano-British pottery.

BURNT CLAY. Much burnt clay was found, and one or two pieces show impressions of sticks. Messrs A. S. Kennard and Reader are in perfect agreement in describing these as follows: "The portions of burnt clay with impressions of stick are the remains of 'Wattle and daub' work of a house. The structure caught fire, and the wood burnt, leaving the partially burnt clay as the evidence of the conflagration." The pieces in question were found near pit (a) Type I.

COINS. Three Roman coins were found in the Stone Band. They were three and a half feet below the surface-soil, and eleven inches above the old soil. They were found together on a large stone, not in any way connected

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with the old soil. The following is a description of the coins by Mr H. A. Grueber, F.S.A., of the British Museum:—

Base denarii of Carausius and Allectus, struck in London.

1 Carausius.

*Obverse.* IMP. C. CARAVSIVS P. F. AVG. [*Imperator Cæsar Carausius Pius Felix Augustus*]. Bust with radiate crown and in armour.

*Reverse.* PAX AVGG [i.e. *Pax Augustorum*]. Pax standing, holding branch and sceptre; in the field, S.P. [*signata prima:* i.e. first issue]: below, M. L. -XXI [*Moneta Londinensis* 21: i.e., 21 to the old silver denarius].

2 Allectus.

*Obverse.* IMP.C. ALLECTVS. P.F.AVG. [see previous coin]. Bust with radiate crown and in armour.

*Reverse.* PROVID. AVG. [*Providentia Augusti*]. Providentia standing, holding globe and cornucopiæ; in field, S.P.; below, M.L. [see previous coin].

3 Similar, but on *Reverse.* Providentia holds in her right hand a sceptre, with which she touches a globe: in field, S.M. [*signata moneta*].

These coins were struck in A.D. 293 in London.

The coins when found were in perfect mint condition, and had the appearance of being silver-gilt. They must have been covered up soon after being struck.

In the Stables Quarry (see map) shallow pits of Type III. are to be seen, and from these pottery and bones similar to those from King's Beeches have been obtained. Near the Stables Quarry we have marked on the map what appear to be intrenchments—probably indicating part of

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the settlement. We have also marked on the map the intrenchment which runs from near the top of Cleeve Cloud along the northern side of Postlip Hollow. This intrenchment has been variously interpreted. By Mr John Sawyer[1] it is regarded as a tribal boundary.

It seems highly probable that the ground lying between Wickfield Lane and the King's Beeches was occupied in the Iron Age. This may be assumed from the sawn antler of red deer and the saw-cut in the horn-core of *bos longifrons*, as well as from the pottery and tools found, and from an almost entire absence of flints. The Stone Mortar or Mill indicates that agriculture was practised to some extent. It is difficult to decide for what purposes the pits were used. We think Type I. may have been pit-dwellings, or they may have been covered pits used for storing grain. The small pits of Type II. may have served several purposes, as for instance, store-pits for clay, kilns for pottery, or cooking pits.

There is not yet sufficient evidence to enable us to state more definitely the period of the occupation of the site at the King's Beeches; but it is very probable that the remains indicate a settlement of some Celtic tribe—perhaps the Dobuni, before the Romans conquered this part of the country. Apart from this opinion, the paper deals only with outlines of the results obtained.

It is unfortunate that operations have been discontinued at that part of the quarry in which further interesting discoveries were anticipated.

Our thanks are due to many friends, particularly to Mr A. S. Kennard, for information and assistance in course of the work of investigation.

1 Proc. Cotteswold Nat. F. C., Vol. xii., pt. 1 (1895-96), p. 83.

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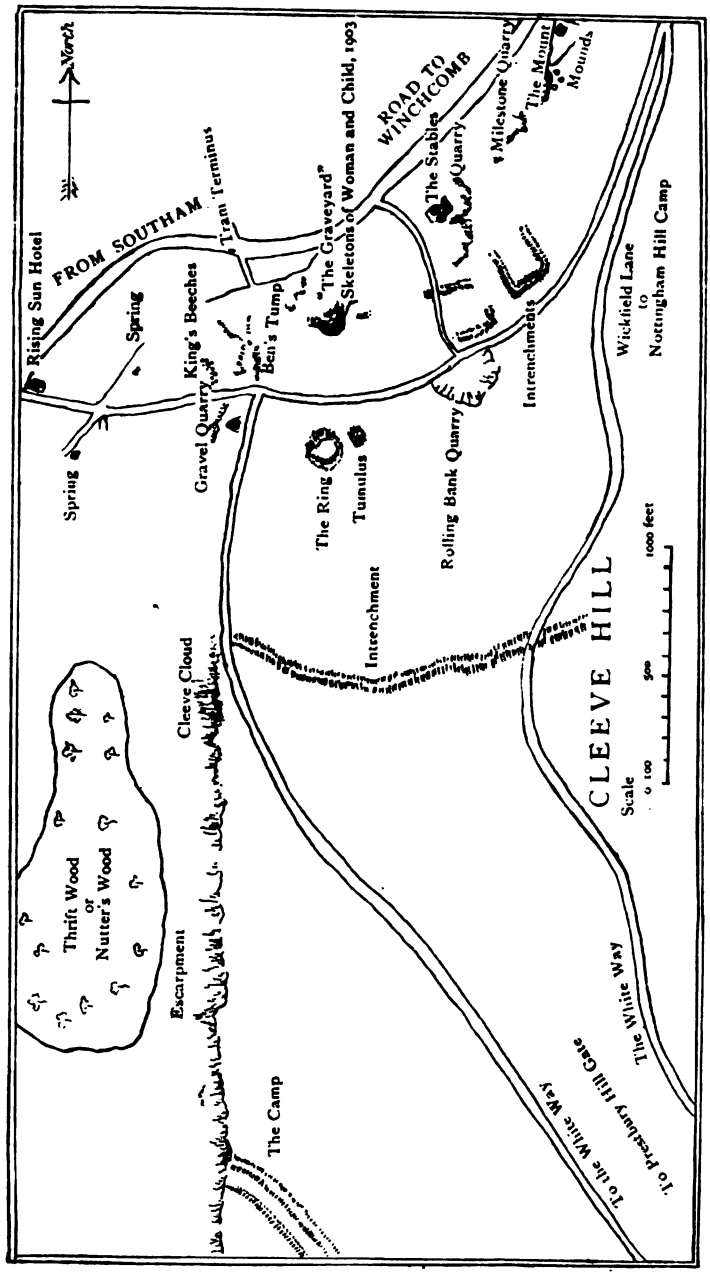


Fig. 2.—SKETCH-MAP OF THE NORTH-WEST PORTION OF THE CLEEVE-HILL PLATEAU.

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# APPENDIX.

## THE VERTEBRATE AND MOLLUSCAN REMAINS FROM CLEEVE HILL

BY

**M. A. C. HINTON and A. S. KENNARD.**

The vertebrate and other remains which have been so kindly submitted to us by Mr Brewer are of the greatest interest. It cannot be too strongly urged that at the present time we possess far too little information about the earlier races of domesticated animals. Practically the only scientific work that has been done in this country is to be found in the publications of the late General Pitt Rivers, on the excavations in Cranborne Chase, and in the papers of the late Professor G. Rolleston. Measurements are rarely given, investigators being usually content with listing the names of the species, oblivious of the fact that "science is measurement." Few people who have not worked at such remains can appreciate the numerous minor problems which continually confront and too often baffle the osteologist in his endeavours, be they directed towards specifically distinguishing the various animal-remains, or towards elucidating the mysteries of abnormal development. The osseous-remains from Cleeve Hill, though numerous, are very fragmentary, and by no means easy to determine. Their fragmentary condition arises from two causes: the bones having been split by man for marrow, whilst many of these fragments—as well as practically all the smaller bones—have been gnawed by

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dogs. In spite of these drawbacks, we have, however, been able to obtain some satisfactory results.

### *Homo sapiens.*

The only human bone forwarded is a fragment comprising the lower two-thirds of a right humerus. The distal articulation has been gnawed off, and the broken proximal end has been similarly treated, subsequent to the fracturing. The medullary cavity was lined with aragonite.

### *Canis familiaris* (Dog.)

The gnawed bones abundantly testify to the presence of this species, although the only actual remains that we have noted were a right ramus, from which all the teeth except m. 2 have dropped out, and two canine teeth. These apparently indicate a breed of dog similar in size to the modern sheep dog, and therefore evidently long domesticated.

### *Equus caballus* (Horse.)

The horse is abundantly represented in this series, and appears to have been of modern size, about 13 hands high. Unfortunately the long bones have all been broken for the marrow. A fragmentary right tibia measures 4·25 inches in minimum circumference. The dimensions of the astragali are :—

| | | |
|---|---|---|
| Width of navicular articulation | 1·80 | 1·87 |
| Height ..... ..... | 1·14 | 1·28 |
| Width of trochlear ridges ..... | 1·43 | 1·42 |

A tooth, right m. 3, measures 1·18 by 0·51, and a right m. 2, 1·16 by 0·59 inches.

Remains of this species occurred in all parts of the workings. The bones evidently belong to the same type of horse as was existent in the Romano-British village at Rushmore—a type which appears to have been characteristic of the Late Celtic and Roman periods.

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*Sus scrofa*, var. *domesticus* (Pig.)

The remains of this species were very numerous, and occurred in all parts of the pits. They indicate animals of all ages, from sucking-pigs onwards, and nearly all the bones have been broken for the marrow. From the circumstance that all the animals had been killed while still young (although in one case full-grown) and from the comparatively small size, there can be no doubt that they belonged to domestic and not to wild swine. There are several canine teeth, all of medium size.

The following are the dimensions of some of the remains:—A right humerus, without the proximal epiphysis, measures 6·5 in length, and has a minimum circumference of 3·1. The distal articulation of another humerus measured transversly 1·46; distal end of a tibia 0·88 by 0·91.

The oldest individual was represented by a fragment of a left ramus, which carried the m. 3, but this tooth had only just come into wear. The m. 3 measures 1·30 by 0·59.

In a fragmentary right ramus, the m. 1 and m.2 measured 0·66 by 0·40 and 0·79 by 0·43 respectively.

*Bos longifrons* (Ox.)

Three horn-cores and a large number of teeth and fragmentary bones represent this species. The horn-cores are of an extremely interesting type, since they are very much compressed before and behind, so as to be narrowly elliptical in section. The length, as measured along the outer curve, from the base to the tip, is a trifle less than the circumference at the base. The following are the dimensions of the three specimens:—

| | 1 | 2 | 3 |
|---|---|---|---|
| Circumference at base ..... | 6·25 | 5·25 | 3·7 |
| Greatest diameter ..... | 2·50 | 1·70 | 1·40 |
| Extreme length, measured along outer or upper curve | 6·00 | 4·80 | 3·00 |

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It is worthy of note that No. 2 has had its top partly sawn through by an iron tool. No. 3 evidently belongs to a young individual. There are no specimens in our collections which exhibit such compression, and on examination the fine collection of ox-remains in the possession of Dr Frank Corner also failed to yield a similar example. In all the examples of early oxen we have seen the section is more nearly circular than in those from Cleeve Hill. There is no doubt, however, that we have here a local race of *Bos longifrons*. The teeth represent every individual age from the calf to the old cow, and many of them show traces of alveolar abscesses and similar morbid developments. An identical state of affairs is also found in the sheep-remains from Cleeve Hill, and it appears that these diseases which evidently affected a very considerable percentage of the Cleeve Hill stock resulted from morbid conditions, set up by early domestication, just as in the case of elephants, the improper or unnatural feeding, consequent upon their captivity and taming, produces the abnormal intercalated ridglets in their molars.

The following measurements of a series of milk-molars may be of use for comparison:

| Lower-Milk-Molars | Millimetres m m 3 | Millimetres m m 4 |
|---|---|---|
| *Bos longifrons*, Cleeve Hill | 17·5 by 9·2 | 28·5 by 10·5 |
| ,, ,, ,, | | 31·0 by 11·0 |
| ,, Walthamstow[1] | | 31·5 by 12·6 |
| ,, Swanscomb | | 30·2 by 12·2 |
| Recent Short Horn ..... | 18·3 by 9·5 | 33·5 |
| ,, ,, ,, ..... | 17·2 by 9·3 | |
| *Bos primigenius*, Ilford | | 39·2 by 16·6 |

Most of the limb bones are too broken to yield either measurements or comparisons of importance. Some

1 The Walthamstow example is from the alluvium of the River Lea. The age is uncertain; but it is early—perhaps late Celtic. The Swanscomb specimen was obtained from a Denehole at that place, and is certainly pre-Roman. The example of *Bos primigenius* is from the middle terrace (Pleistocene) of Ilford.

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fragmentary metatarsals, however, agreed, as far as they were preserved, very closely with the corresponding bone in the skeletons obtained from a Denehole at Swanscomb, Kent, and pronounced by Dr Dürst, of Zurich, to be true *Bos longifrons*.

Measurements of two right calcarea from Cleeve Hill :

| | 1 | 2 |
|---|---|---|
| Extreme length ..... ..... | 4·70 | 4·50 |
| Minimum circumference of shaft | 3·30 | 3·10 |
| Extreme Width ..... ..... | 1·38 | 1·20 |

Although a careful search was made, no trace of the occurrence of *Bos primigenius* was detected : a species which is not infrequently represented in collections from similar situations of equal antiquity.

*Ovis aries* (Sheep.)

The remains of the sheep occurred in great profusion, and it is evident that this animal was largely used for food. Practically all the limb-bones have been broken. Not a fragment of a skull or horn-core has occurred, which is noteworthy as well as unfortunate. A considerable number of the bones are those of lambs. It is quite possible that the goat is represented, though no fragment has yet been recognized which could be definitely said to belong to that species.

The teeth of the sheep, as already noted, show in many cases traces of alveolar abscesses.

Measurements of the distal end of a small right metatarsal from Cleeve Hill, and some corresponding ones taken from a series in the collection of Dr F. Corner :

| (Millimetres) | Distal articulation Vertical Diameter | Transverse Diameter |
|---|---|---|
| Cleeve Hill ..... ..... | 13·8 | 20·9 |
| Walthamstow alluvium ..... | | 22·5 |
| ,, ,, ..... | 14·7 | 22·2 |
| ,, ,, ..... | 15·8 | 23·0 |
| Becton ,, ..... | 14·0 | 22·8 |
| St Luke's (London) alluvium | 15·3 | 22·8 |

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So far as size is concerned, these specimens approach the St Kilda and Heather sheep very closely.

*Cervus elaphus* (Red-deer.)

Only two specimens could be referred to the Red-deer. First, a fragment of the last lower molar of the left side. The third or hind lobe had been broken away, but from the crescentic islands of enamel, the low crown, and the little tubercle in the outer interspace between the first and second band, there can be no doubt as to the identification. The other example was a portion of an antler which exhibited marks of sawing with an iron tool.

*Capreolus capreolus* (Roebuck.)

Two lower jaws, broken off behind, and one or two detached teeth, are all the remains that can satisfactorily be said to belong to the Roebuck. The lower jaws are easily distinguished by the low crowns and form of their molar teeth from those of the sheep.

*Microtus agrestis* (Field Vole.)

Two lower jaws—a right and a left—each with the first and second cheek teeth in place, are referred to this species, agreeing as they do with that species in size, and in the pattern of four inner and five outer angles possessed by the first true molar.

*Microtus (Erotomys) glareolus* (Bank Vole.)

A left ramus of a young individual is referred to this species, on the ground of the close agreement of the pattern of the first molar with that of the corresponding tooth in recent lower jaws. The anterior extremity of this pattern agrees very closely with that of the form

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figured by Blasius in his fig. 177 *(Säugethiere Deutschlands*, p. 338.)

Besides these jaws, there are several limb bones of small rodents, which have not been determined satisfactorily.

*Sorex vulgaris* (Common Shrew.)

Two upper jaws, evidently from the same individual, and with all the molar teeth in place, are referred to the Common Shrew, as they agree in size and form with this species. They are labelled as coming "from the 'Stonebed,' just above the 'old soil,'" and they are more recent than the other remains.

*Gallus domesticus* (Common Fowl.)

A right femur, and various other bones and fragments, some of them charred ("the charred fragments came from the Black Band") represent the Common Fowl. This species has not been found in deposits earlier in date than the Bronze Age in Britain.

*Rana temporaria* (Common Frog.)

A distal end of a humerus, and a fragment of a small tibio-tarsus, we would assign to this species.

There are also two or three imperfect bones of small passerine birds, which we have been unable to satisfactorily determine.

MOLLUSCA.

A large number of land mollusca was sent to us from various parts of the excavations, as well as a large quantity of the old soil. This on being washed yielded many small species, whilst several examples were obtained from material contained in the larger forms.

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TABLE

| SPECIES | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| *Limax arborum* Bouch. Chant. | | | | | | X |
| *Agriolimax agrestis* (Linne) | X | | | | | |
| *Vitrea crystallina* (Müll.) | X | | | X | | X |
| " *cellaria* (Müll.) | X | X | X | X | X | X |
| " *alliaria* (Mill.) | X | | | X | | |
| " *nitidula* (Drap.) | | | | | | X |
| *Arion ater* (Linne) | X | X | X | | X | X |
| " *hortensis* (Fer.)? | | | | | | X |
| *Pyramidula rotundata* (Müll.) | X | | X | X | X | X |
| *Helicella itala* (Linn.) | X | X | X | X | | X |
| *Hygromia hispida* (Linn.) | X | X | | X | X | X |
| " *rufescens* (Penn.) | X | X | | | X | X |
| *Acanthinula aculeata* (Müll.) | | | | | | X |
| *Vallonia pulchella* (Müll.) | | X | X | | X | |
| *Helicigona arbustorum* (Linn.) | X | | | | | X |
| " *lapicida* (Linn.) | X | X | | | | X |
| *Helix nemoralis* Linn. | X | X | X | X | X | X |
| " *hortensis* Müll. | X | | X | | | |
| *Ena montana* (Drap.) | X | | | | | X |
| " *obscura* (Müll.) | X | X | | X | | X |
| *Cochlicopa lubrica* (Müll.) | X | | | X | | X |
| *Jaminia secale* (Drap.) | X | | | X | X | X |
| " *muscorum* (Linn.) | | | X | | | |
| *Clausilia laminata* (Mont.) | | X | | | | X |
| " *bidentata* (Ström) | X | | X | | X | |
| *Carychium minimum* Müll. | | | | | X | |
| *Pomatias elegans* (Müll.) | X | X | | X | X | X |

A Shells from quarry tip.
B From the soil to the right of quarry : 2½ feet deep or more.
C From the dirt band on top of the small pit, approximately old soil.
D From stone band just above the old soil.
E From gravel and dirt at the right-hand corner of quarry.
F From the old soil.

One example of **Helix nemoralis** was obtained from the black band of the pit, and one from the gravel, two feet deep *in situ*. The calcareous granules representing the internal shell of *Arion* were extremely abundant. It is notoriously difficult to determine the species of this genius from these scanty remains, and yet in all probability at least two forms are present—*Arion ater* and *A. hortensis*.

**Vitrea cellaria** is also an abundant form, and attains a large size : examples being 12 mm. in diameter. Some of the specimens are broken, and the animals have evidently been eaten by mice.



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The examples of **Vallonia pulchella** are the true *pulchella*, and not the allied forms *V. costata* (Müll.), or *V. excentrica*, Sterki, which are frequently "lumped" with it.

**Ena montana** and **E. obscura** are extremely rare in a fossil state, which is the more remarkable since both forms are known from the Pleistocene of Barnwell. The first-named is a true woodland species, whose area of distribution in England has greatly diminished in quite modern times.

All the examples of **Cochlicopa lubrica** are extremely small, and exactly resemble the form occurring on the coast sandhills of Ireland.

**Jaminia (Pupa) secale** is another rare form in beds of any age. It is known from the Pleistocene and Holocene of Dover and the Holocene of St. Catherine's Down, Isle of Wight.

Judging from the species represented and their relative proportions, they indicate moist woodland conditions, and are of great importance as showing the molluscan fauna in pre-Roman or early Roman times. All the species are known to live in the county, but it is quite possible that a collection of existing species would show that other forms have migrated into the area since Roman times, and one form, *Helicella caperata* (Mont.,) which now lives commonly in the locality, is absent from the old soil, and thus is obviously a modern immigrant.

## CONCLUSIONS.

From the above facts it is possible to come to fairly definite conclusions as to the age of the settlement. These folk had domesticated the horse, ox, sheep, pig, and fowl, which they used as food. The horse was of the size usually found in pre-Roman times, the sheep was smaller than any Roman sheep we have seen, and the ox was also a small breed. In all these there is no trace of

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the larger breeds which were introduced probably in Roman times. They possessed a dog similar in size to a sheep-dog, and perhaps used for the same purpose. They were in the Iron age, as is proved by the saw marks on the antler and horn-core. Hunting apparently was not carried on to any great extent, since the remains of Roe-deer and Red-deer are extremely scanty. They must have been a sedentary people, since otherwise they could not have kept swine. There is no direct evidence that they were agriculturists, but in all probability they were. There is only one age to which such a folk could be assigned, namely, the early Iron age. That is the state of civilization to which they had attained. One cannot term it late Celtic, since we have no evidence as to race. Thus we have a small community of people with flocks and herds. These, with the aid of man, would quickly disafforest the district, and the woodland molluscan fauna, which is well represented in the old soil, would quickly die out, and those species whose natural habitat is open country would take their place.

In conclusion, we would take the opportunity of thanking Mr L. Richardson and Mr Brewer for their kindness; and we would also express our thanks to Dr Frank Corner, who has kindly permitted us to make use of his collection for purposes of comparison on this as on so many other occasions.



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# THE PEOPLE OF INDIA

BY

W. CROOKE, B.A., F.A.I.

(Read March 8th, 1904)

REPORT BY LECTURER.

On 8th March, 1904, Mr W. Crooke, B.A., F.A.I., delivered a lecture before the Field Club on The People of India. He began by explaining the difficulty of discussing the ethnology of a country which is rather a Continent than a Peninsula, occupied by some 300 millions of people, differing widely in race, language and religion. After sketching generally the variety of types of people to be found in the Bhendi Bázár at Bombay, he proceeded to show that they fall into two main groups—the Aryan and Dravidian. The Aryans appear to have reached India from the Central Asian Steppe. But the term Aryan is linguistic rather than ethnical, and doubtless included more than one type, but all influenced by common institutions and language. The so-called Aryan invasion was probably the result of the desire of all northern races to reach the sea and the sunshine. It was possibly not a well-defined invasion by a conquering race, but the movement was gradual, and almost certainly occupied a long period of time, the occupation of the Indian Peninsula being the result rather of the moral and intellectual

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superiority of the new-comers than of a military conquest. We first find them about 1200 B.C. in the Panjáb, and thence they gradually occupied the Ganges-Jumna valley. At least two distinct movements of this kind are reflected in the distribution of the modern vernacular tongues, besides a Scythic invasion, which occurred about the commencement of our era.

They found in occupation of the country a people now known collectively as Dravidians; but these probably represent several distinct types—first, an Indo-Malaysian element which presents some affinity to the African type, and which is supposed by some to have entered India along the now submerged continent, of which Madagascar, the Laccadives and Maldives represent the highest summits. This type is now apparent in the Veddahs of Ceylon, the inhabitants of the Andaman Islands, and the forest tribes of Madras and the Malayan Peninsula. Secondly, the pure Dravidians, who possibly came to India from the valleys of the Tigris and Euphrates. Part of these may have come by land, because the Brahuis of Beluchistan speak a Dravidian tongue: possibly many came by sea, because in early times there seems to have been active intercourse between Babylon, through the Persian Gulf, and India. Thirdly, tribes of Kolarian speech, who probably came from the north-west through some of the Himalayan passes. Fourthly, a Mongoloid people, who passed into India from the Tibetan plateau.

From the combination of these various types with the Aryans resulted the present population. From the point of view of anthropometry the resultant type is remarkably uniform. Both Aryans and Dravidians are dolichocephalic, and dolichocephaly tends to increase as we move north, where the Aryan element is preponderant; the lower Ganges valley is occupied by a mesaticephalic race. The prominent feature which differentiates the Dravidian, as

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opposed to the Aryan type, is the width of nostril. Part of these pre-Aryan peoples were enslaved by the Aryan, and now form the large mass of menial castes: part in the highlands of Central India, and the two mountain ranges which flank the southern part of the Peninsula, remained undisturbed up to our own time.

The sociology and condition of these tribes, such as Bhíls, Gonds and Santáls were discussed, and some account was given of their marriage and death rites, particularly in connexion with the latter, the ideas of the future state of the soul after death, as reflected in the customs of earth burial and cremation, were considered.

The question of caste was next discussed, and it was pointed out that the common Hindu belief that it existed from the very early times, and was peculiar to India, was erroneous. It does not appear in the Veda, and was probably only in process of evolution at the period when Buddhism arose, in the 5th century B.C. Something like caste, again, appears in Egypt, Greece, Rome, and even in modern Europe. It seems to have resulted from the contact of the foreign and indigenous peoples. It was partly, that is to say, racial: but in a large measure occupational, the impulse being probably given by the specialisation of priestly functions among the Brahmans, which was brought about by the increasing formalism of ritual. The constant growth of new castes by a process of fusion, and the rules of endogamy and exogamy, were illustrated as they appear at present. After a short reference to the social and economic results of the caste system, the lecture closed with the exhibition of a series of photographic slides representing some of the most prominent ethnical types.

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# PROCEEDINGS

OF THE

# COTTESWOLD NATURALISTS'

# FIELD CLUB

PRESIDENT

REV. WALTER BUTT, M.A.

HONORARY SECRETARY

L. RICHARDSON, F.G.S.

Vol. XV. Part II.

June, 1905

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GLOUCESTER

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H. Y. J. Taylor, 3 Falkner Street, Gloucester.
H. B. Woodward, F.R.S., Geological Survey, 28 Jermyn Street, London.

## Members:

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| Bishop, W. ... ... ... ... | The Brick House, Stroud. |
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| Butt, Rev. Walter, M.A. ... ... | Kempsford Vicarage, Fairford, Glos. |
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| Cullis, F. J., F.G.S. ... ... ... | Barnwood, Gloucester. |
| Currie, G M. ... ... ... ... | 26 Lansdown Place, Cheltenham. |
| Dorington, Sir J. E., Bart., M.P. ... | Lypiatt Park, Stroud. |
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| Evans, Rev. J., B.A. ... ... ... | Rosedale Villas, Kings Rd., Cheltenham. |
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| Gray, J. W., F.G.S. ... ... ... | St. Elmo, Leckhampton Rd., Cheltenham. |
| Grosvenor, W. W., M.D. ... ... | 4 Clarence Street, Gloucester. |
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| Hayward, Archdeacon H. R. ... ... | College Green, Gloucester. |
| Hedley, G. W., M.A., F.C.S. ... | The College, Cheltenham. |
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| Jordan, W. H., B.A. ... ... ... | 8 Royal Parade, Cheltenham. |
| Kay, Sir Brook, Bart. ... ... ... | Battledown, Cheltenham. |
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| Knowles, H. ... ... ... ... | Egerton House, Spa Road, Gloucester. |
| Leigh, William ... ... ... ... | Woodchester Park, Stonehouse, Glos. |
| McLaughlin, H.W.C., M.A. ... | c/o Messrs Sawbridge, 68 Aldermanbury, |
| Margetson, W. ... ... ... ... | Bright Side, Stroud. [London, E.C. |
| Marling, Sir William H., Bart. ... | Stanley Park, Stroud. |
| Marling, W. J. Paley ... ... ... | Stanley Park, Stroud. |
| Marling, S. S. ... ... ... ... | Stanley Park, Stroud. |
| Medland, M. H., F.R.I.B.A. ... | Horton Road, Gloucester. |
| Mellersh, W. L., M.A. ... ... | The Gryphons, Pittville, Cheltenham. |
| Meredith, W. L., F.G.S. ... ... | 7 Midland Road, Gloucester. |
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| Mitchinson, Right Rev. J. ... ... | College Gardens, Gloucester. |
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| Newton, Surgeon-Major Isaac ... | Broadlands, The Park, Cheltenham. |
| Norris, H. E. ... ... ... ... | Cirencester. |
| Paine, Alfred E. W. ... ... ... | Churcham Court, near Gloucester. |
| Perkins, Vincent R. ... ... ... | Wotton-under-Edge. |
| Phillips, J. G. ... ... ... ... | Sunnyside, Denmark Road, Gloucester. |
| Prevost, E. W., Ph.D., F.R.S.E. ... | Weston, Ross. |
| Rankin, J. R. L. ... ... ... | Ashmead, Dursley. |

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| Ringer, Dep. Surgeon-Gen. T. ... | 20 Lansdown Terrace, Cheltenham. |
| Ryves, Captain A. ... ... ... | Taynton, Charlton Kings. |
| Sawyer, John ... ... ... ... | Battledown, Cheltenham. |
| Scobell, Canon E. C., M.A. ... ... | Upton St. Leonards, Gloucester. |
| Sewell, E. C. ... ... ... ... | The Beeches, Cirencester. |
| Skinner, J. W. ... ... ... ... | The Edge, Stroud. |
| Slater, A. ... ... ... ... | Horton Lawn, Gloucester. |
| Smith, A. E. ... ... ... ... | The Hollies, Nailsworth. |
| Smith, V. A., M.A. ... ... ... | Hazelwood, The Park, Cheltenham. |
| Stanton, Walter John ... ... ... | Stratford Lodge, Stroud. |
| Stanton, C. H., M.A., F.R.G.S. ... | Field Place, Stroud. |
| Taynton, H. J. ... ... ... ... | 8 Clarence Street, Gloucester. |
| Thomas, Arnold, F.G.S. ... ... | Severn Bank, Newnham-on-Severn. |
| Thompson, W. ... ... ... ... | Lansdown, Stroud. |
| Upton, Charles ... ... ... ... | Tower House, Stroud. |
| Waller, F. W. ... ... ... ... | Horton Road, Gloucester. |
| Washbourn, William ... ... ... | Blackfriars, Gloucester. |
| Watson, Dep. Surgeon-Gen. G.A. ... | Hendre, Cheltenham. |
| Wethered, E. B., F.G.S. ... ... | The Uplands, Cheltenham. |
| White, H. L., B.A. ... ... ... | 2 St Margaret's Terrace, Cheltenham. |
| Wilkinson, Rev. L., B.A. ... ... | Micheldean, S.O., Glos. |
| Winnington-Ingram, Rev. A. R. ... | Lassington Rectory, Gloucester. |
| Winwood, Rev. H. H., M.A., F.G.S. | 11 Cavendish Crescent, Bath. |
| Witchell, E. Northam ... ... | Lansdown, Stroud. |
| Witts, G. B., C.E. ... ... ... | Leckhampton, Cheltenham. |
| Witts, Rev. F. E. B., B.A. ... ... | Upper Slaughter Manor, Lower Slaughter, R.S.O., Glos. |
| Wollaston, G. H., F.G.S. ... ... | La Mascotte, Lausanne, Switzerland. |
| Wood, Walter B. ... ... | Barnwood, Gloucester. |

*(Any corrections in this List will be gladly received by the Hon. Secretary.)*

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# LIST OF SOCIETIES, INSTITUTIONS, &c.,

## To whom Copies of the Club's Publications are presented.

*An asterisk denotes those from whom publications are received in exchange.*

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*†THE BATH NATURALISTS' FIELD CLUB, c/o The Librarian (T. S. Bush), Royal Literary Institution, Terrace Walks, Bath.

*†THE BRISTOL AND GLOUCESTERSHIRE ARCHÆOLOGICAL SOCIETY, c/o The Librarian, Eastgate, Gloucester.

*†THE BRISTOL NATURALISTS' SOCIETY, c/o C. King Rudge, L.R.C.P., 145 White Ladies Road, Redland, Bristol.

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†The Presidents and Secretaries of these Societies are considered as Ex-officio Members of the Club, and are cordially invited to the Meetings; Programmes of Meetings to be sent to them as invitations.

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## INCOME AND EXPENDITURE FROM

### RECEIPTS

| | £ | s | d | £ | s | d |
|---|---|---|---|---|---|---|
| BALANCES— | | | | | | |
| Brought from last Account, Cash ... ... ... | 1 | 1 | 3 | | | |
| Deposit Account ... ... ... ... ... | 52 | 3 | 8 | | | |
| Current " ... ... ... ... ... | 5 | 16 | 4 | | | |
| | | | | 59 | 1 | 3 |
| INCOME— | | | | | | |
| Interest on Deposit Account to 31st Dec., 1904... | | 16 | 6 | | | |
| Proportion of Rent (Archæological Society) ... | 8 | 0 | 0 | | | |
| Subscriptions to 4th April, 1905 ... ... ... | 65 | 0 | 0 | | | |
| | | | | 73 | 16 | 6 |
| | | | | £132 | 17 | 9 |

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## 20TH APRIL, 1904, TO 4TH APRIL, 1905.

### PAYMENTS

| | £ | s | d | £ | s | d |
|---|---|---|---|---|---|---|
| Secretary's Expenses ... ... ... ... ... ... | | | | 6 | 13 | 5 |
| J. Bellows, Rent of Room ... ... ... ... ... | | | | 9 | 0 | 0 |
| Printing ... ... ... ... ... ... ... ... | | | | | 7 | 6 |
| Miscellaneous Expenses ... ... ... ... ... ... | | | | | 6 | 8 |
| J. Bellows, on acct. of Printing Proceedings ... ... ... | | | | 20 | 0 | 0 |
| Municipal Schools, Use of Room for Meetings ... ... | | | | 2 | 17 | 0 |
| Custodian ... ... ... ... ... ... ... ... | | | | | 9 | 8 |
| Coffee Co., Refreshments ... ... ... ... ... ... | | | | 5 | 0 | 0 |
| Norman, Sawyer & Co., General Printing, &c. ... ... ... | | | | 17 | 0 | 10 |
| BALANCES— | | | | | | |
| At Deposit Account, Capital and Counties Bank | 53 | 0 | 2 | | | |
| " Current Account " " " " | 18 | 2 | 6 | | | |
| | | | | 71 | 2 | 8 |
| | | | | £132 | 17 | 9 |

A. S. HELPS, *Hon. Treasurer.*

Audited and found correct, 19th April, 1905

H. KNOWLES.

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## RULES OF THE CLUB

1.—The Objects of the Club are to study the Natural History and Antiquities of the County and the adjacent districts.

2.—The Club shall consist of a President, Vice-Presidents (not exceeding seven in number), an Honorary Secretary, an Honorary Treasurer, and Honorary Librarian, and Honorary, Ordinary and *Ex-officio* Members.

3.—Before anyone can be elected a Member he must be duly proposed and seconded at an Ordinary Meeting, and come up for ballot at a subsequent Meeting; one black ball in ten to disqualify.

4.—The Entrance Fee shall be £1. The Annual Subscription of Ordinary Members shall be Fifteen Shillings, due in advance on the first day of January.

5.—Any Member in arrear with his Subscription for the year is liable to removal from the list of Members.

6.—No Member shall be entitled to a copy of the Proceedings whose Subscription is one year in arrear.

7.—The Club may admit a limited number of Honorary Members (see Rule 2), whose scientific work entitles them to the distinction, and who must be elected at the Annual Meeting.

8.—The Executive Council for the Management of the Club shall consist of the President, Vice-Presidents, the Honorary Secretary, the Honorary Treasurer, and Honorary Librarian, all of whom shall retire at the Annual Meeting, but are eligible for re-election.

9.—The Annual Meeting shall be held in the early part of each year, at which Meeting the President's Address shall be read, the Financial Statement of the Honorary Treasurer shall be presented, and the Officers shall be elected, and the dates and places of the Field Meetings be fixed; but the arrangements for the Winter Meetings shall be left to the Executive Council.

10.—The Club shall usually hold yearly four Field Meetings, and also four Winter Meetings for the reading and discussion of Papers. At the Field Meetings any Member may introduce one Visitor, and at the Winter Meetings more than one; and at the Winter Meetings the term "Visitor" may include ladies. Members must give due notice to the Honorary Secretary of their intention to be present at any Field Meeting, and should any Member, having given such notice, fail to attend, he will be liable for his share of the expenses.

11.—The Council may at any time call a Special General Meeting of the Members. Upon the requisition of any eight Members being sent to the Honorary Secretary, a Special General Meeting shall be convened; and any proposition to be submitted shall be stated in the Notice. Not less than seven days' notice of any such General Meeting shall be given.

12.—The Club shall use its influence to promote the preservation of all antiquities and to prevent, as far as possible, the removal of scarce plants and the extermination of rare species of the flora or fauna.

Adopted at the Annual Meeting of the Members at Cheltenham, April 27th, 1896; and revised at the Annual Meeting at Gloucester, April 23rd, 1901.

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# ANNUAL ADDRESS

TO THE

## COTTESWOLD NATURALISTS' FIELD CLUB,

BY

**The Rev. WALTER BUTT, M.A.**, *President.*

(Read at Gloucester, April 4th, 1905)

Our Club, I am happy to record, is strong alike in its numbers and the output of its members, both as regards actual research into the obscure part of the workings of the human mind, as well as into the things done by the efforts of organized life, and matter under all its forms.

I remark that our Club is strong in numbers. I believe I am correct in stating that, with the election of our last new member, we number 100—a greater number than ever before in our history. Only two members have resigned their membership, both of whom are to be regretted. One of them, at any rate, left us without having a word to say in disparagement of the Club, and we rejoice to think of him as taking part as an active member, and most keen officer, of a society working upon much the same lines as our own.

Speaking of members leads us to record losses by death from the ranks of those actually belonging to our own body or of those closely in touch with us.

Among the latter—for happily *our* ranks were not thinned in this way during the last year—we must name that veteran worker in geology R. F. Tomes,, F.G.S., and a J.P. for the county of Worcester. He died at the age of 81, at Evesham, in July of last year. He published much that has always been considered valuable, and I



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believe it was a paper of his in our Proceedings, respecting the stratigraphical horizon whence a *Gryphæa* was obtained by himself, in the Lias at Bridgend, Glamorganshire, that led to much discussion among the prominent geologists of the country at large, as well as those of our own county.[1] He dealt much with the fossil-corals of our own district, and published a useful paper in our Proceedings.[2]

Otherwise in this respect was it with another well-known geologist, whose death we cannot but regret. I allude to Mr H. D. Hoskold, F.G.S., Inspector-General of Mines of the Argentine Republic, and Director of the Government Department of Mines and Geology. Happily some of his work is enshrined in our Proceedings. In Vol. X. we can read an elaborate and most interesting essay by him, entitled "A Geological Notice upon the Forest of Dean;" and he collaborated with his brother, Mr Carlos Hoskold, in presenting us with a collection of South American Indian Objects, made in the Argentine Republic from 1882 to 1886, and now deposited in the Gloucester Museum. A catalogue of this collection, compiled by him, appears in Vol. XI.

After our numbers, we have whereof to boast in the literary output of so many of our members. It is probable that I am unable to give you an exhaustive list of the books and articles in scientific journals and magazines to which the names of members of our club are appended. But from what I *am* able to record, it will be recognised that the Cotteswold Naturalists' Field Club is a force to be reckoned with when the day comes, if ever it does come, or needs to come, for the vitality of a club such as ours is to be estimated not merely by counting heads, but by setting down what those heads have produced in print for the advancement in knowledge of those equally desirous

1 Proc. Cotteswold Nat. F. C., Vol. iii., pt. 2 (1863), pp. 192-194.
2 *Ibid.*, Vol, ix., pt. 3 (1887-88), pp. 300-307.

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with themselves to read the past, and thus better understand the present, and also to endeavour to determine what the future may have in store.

If I make no mention of what the columns of the daily or weekly press have to show, in regard to the energy of certain of our Club, it is not because I despise that energy, or the direction it took when vented forth. For, honestly speaking, light has been shown in many a dark place, and much pure sophism has been brushed aside by the merciless logic and common sense of those whose efforts I am thinking of. It is much to be thankful for when the correspondence columns of our local papers—to look no further afield—are open to the letters of other than mere chatterers.

But to return to some of the more severe efforts of our members.

Surely first (and that not merely because we would wish to thus thank him for his unstinted zeal for our club, and his ungrudging expenditure of time and trouble in our service, but because it deserves to be referred to first upon its own intrinsic merits), I must mention that most excellent book, "A Handbook to the Geology of Cheltenham and Neighbourhood," by our esteemed honorary secretary. And, perhaps, here is the place where I may be allowed in public to congratulate Mr Richardson upon the honour which the Geological Society of London conferred upon him when they awarded him, as they did last year, the Daniel-Pigeon Award.

Our Secretary has published much besides the beforenamed attractive and illuminating handbook. We all know what his own special subject is, and we have had from time to time opportunities of listening to the results of his investigations. He has given to a larger public the fruits of his labours in the Quarterly Journal of the Geological Society, in the Geological Magazine, in the



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Transactions of the Society of our sister county of Worcester, and of course in our own Proceedings. It is the record of much industry.

From our present we go to our late secretary—late, happily, only as regards his office.

Here again we are confronted with a lengthy list of publications upon the subjects of which he is such an acknowledged master. To give a particular list now might conceivably be thought wearisome. And if the truth must be told, I hardly dare to approach the pronunciation of some of the words to be found. He has published papers in the Quarterly Journal of the Geological Society, the Museums Journal, and Proceedings of the Geologists' Association; whilst he has contributed another part of his standard work on Inferior-Oolite Ammonites to the Palæontographical Society's publications. Mention should perhaps here be made of the fact that the actual amount forwarded to Mr Buckman, as a slight recognition of the Club's appreciation of his services, was £50, and that he acknowledged its receipt in a graceful letter of thanks, which I had the pleasure of communicating to the members present at the first Field-Meeting held at Fairford.

Mr C. A. Witchell published a book in September last, under the title of "The Cultivation of Man." To say the least, it contained some very startling views, set forth, as such views might easily not have been set forth, with an enviable spirit of respect for the views of others. Whatever may be said as to the opinions of the writer, as expressed in his book, we cannot but applaud the temper with which he approaches and deals with his subject. It is not very often that a writer has the courage to look to the public of to-morrow, rather than of to-day, to set the seal of approval or condemnation to his work. This Mr Witchell *has* done.

Mr J. W. Gray has given to the world "Shakespeare's Marriage and Departure from Stratford," which has been

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very favourably reviewed. Probably nothing very new can be said upon the subject, but the author has made several criticisms, the justice of which has been admitted by his reviewers. The last number of our own Proceedings contains excellent matter also from the hands of some of our members, and may be said to be not the least interesting section of a series of Proceedings that has always held high rank among similar scientific publications.

I think that members generally should know that the Council, during the past year, have made arrangements to exchange the Proceedings of the Club for those of the societies in adjoining counties. This should make the contents of our library more useful, both for the officers who have to prepare for our Field Meetings, and for members who may wish to know what is being done in the way of scientific investigation, whether archæological, or more purely naturalistic in character, in districts or counties bordering on our own.

I come now to the recording of the places we visited in the summer, with the briefest of mention of some of the things we saw or did.

To speak first of the meetings generally, and as a whole. They were, judging by the congratulations offered to myself (only, of course, as the representative of your Council) and to our secretary, upon whom lay the burden and heat of carrying out all the preliminary and actual arrangements of each day, considered most successful. They were more numerously attended than usual—at any rate during the last six or eight years of our Club's history; and I think they were more generally interesting to the members taking part in them. We were, without exception, fortunate in our weather. And this was the more to be thankful for, inasmuch as on three out of the four excursions we had to take our lunch picnic fashion, not even *sub tegmine fagi*, but in most exposed places.

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Whatever would have happened to us had it been wet when we gathered on that high ground near Eldersfield? No untoward circumstance marred or hindered our enjoyment on any single occasion. It was not *our* fault that only one or two members of the Bristol Naturalists' Society turned up at our Caerwent meeting, when happily, as I think, *pace* the remembrance of Sir William Guise's opinion as to their presence, we brought ladies with us. And if we had to wait an undue time at Chipping Norton Junction before our conveyances were ready, we have the satisfaction of knowing that that also was not our fault.

Of the half-day meetings I can do no more than record that rumour says they were thoroughly enjoyed, and that much valuable information was given at them. Personally, I was present at none of them, for which I tender my apologies, though I cannot promise to make atonement for the past by a constant attendance at the coming summer's meetings. Exceptions prove the rule. There is not always a Way possible to the Will.

Our first Field Meeting was in my own more immediate neighbourhood. You passed through my parish, and visited a gravel-pit on my glebe. I had not then got into residence, and so an opportunity of showing hospitality to the members present on that day's excursion was lost to me. I feel sore at the very remembrance of it. But the day was very full of interest. And if we failed in deciding whether the world-famed Fairford windows were painted or not by one Apes, as Mr Branch so ably contends against those stalwarts, Mr St Clair Baddeley and the vicar, Mr Carbonell, I feel sure it is only because we lacked time for close inspection.

Our day closed with an acceptance of the kind hospitality of Mr Bowly, at Siddington House, when all too short a time was ours for an appreciation of the many

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treasures our vice-president and Mrs Bowly had to show us. Theirs are names to charm with in archæological circles, as their work in and about Cirencester bears testimony to.

Our June Meeting took us to Tewkesbury, Eldersfield, and the charming Birtsmorton Court. A more delightful day it were almost impossible to conceive. The view from the place where we ate our lunch was of singular interest and beauty. Our secretary, who was, so to speak, on his own ground, read a most lucid paper, in which there was food for thought for the botanist, as he quoted an observation upon the preservation of plants loving the Rhætic shales, as well as for those to whom the earth and its structure is of more account than that growing upon it. About Dick Whittington. Well, I own to as much scepticism about his residence at Eldersfield as I do to the existence of his wonderful cat.

An early start for some of us was involved in the joining the excursion to Caerwent. But that was nothing in comparison with the treat the day gave us. An archæologists' day no doubt, although not altogether so, for our secretary brought us to our bearings once or twice, and so made us remember that we are a Naturalists' Club

But how interesting it all was, and how much we regretted that a lax secretary's clerk was the cause of our not mingling in friendly argument with our Bristol fellow-students. Perhaps it was the absence of numbers—for we looked forward to an exceptionally large company, owing to the joint meeting of two kindred societies—that made our discussions rather tame. Was that really an amphitheatre, or only a cattle-market? We archæologists should have contested the point as hotly as you geologists have done, and I hope will do, the contemporaneity of a bed or some other debateable point in your science.

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Our fourth meeting, and therefore the last of the season, was held in the Chipping Norton district, and the very fact that our return drive would take us through the village of Churchill, the birthplace of "The Father of English Geology," William Smith, was enough to bring us out, if only from respect to his memory, to whom, after all, we owe so much. As one who lives among gravel-pits, your president was naturally delighted to meet, in the Kingham pit, the type of Cotteswold gravel so distinct from his own. Some day or other he looks forward to reading in the Club's Proceedings, or elsewhere—in the former for choice—a really exhaustive paper, or series of papers, upon our local gravels, upon the lines of treatment of the subject—though with the fuller knowledge of to-day—of our late valued member, Mr Lucy.

As usual we were a little too much hurried, and so the fine Chastleton Hill Camp could not be visited.

The Rollright Stones, in themselves eloquent, as they speak of all the mystery of a past that so strangely moves us as we look upon the evidences of their existence, gave Mr Sawyer and the so lately-elected member, Mr W. Crooke, an excellent opportunity of telling us something of the conclusions to which their studies of these and similar standing stones had led them. But where, when all is so obscure, shall the truth be found? An altogether pleasant day was closed by the hearty welcome which Lord and Lady Moreton gave us as we entered their charmingly situated house at Sarsden, and gratefully accepted their hospitality—a fitting end to the Summer Meetings of 1904.

If I dismiss the Winter Meetings in two or three sentences, it will not be because I think them unimportant, for my opinion is far otherwise. They fulfil a distinct function in our corporate life. Those who take the trouble to read papers at these meetings—papers showing

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oftentimes much original research—are deserving of all possible thanks and praise. As also do *they* deserve the same who bring us specimens of geological, palæontological, botanical, or archæological interest.

Time alone fails me in my desire to do such adequate justice to them as lies within my power. Our Secretary has told us at these meetings of what a field is open to one who would give his mind and time to the study of the ostracoda and foraminifera of our Lias and Oolites. The new line between Cheltenham and Honeybourne also was the subject of remarks by him.

Papers full of interest were read by Mr W. R. Carles and Mr W. Crooke upon "Korea," and the "Rude Stone Monuments of India." When they come to be read in our Proceedings, their value will be seen to be even greater than it perhaps appeared to be when in the course of delivery. Dr C. Callaway, Lieut.-Col. J. C. Duke, Mr C. Upton, and last, but far from least, our honorary treasurer, Mr Helps, have all contributed to our enlightenment upon the things of the earth and its forces amidst which we live. Honestly speaking, we are much indebted to one and all of them. And if I, as representing you, have not seemed sufficiently lavish of your thanks, I hope they will pardon me.

And the same gracious pardon I ask you all to extend to me for all my failings as your President.

I should despair of the Republic if I thought of myself. But when I remember that we are a club strong in number, and individually keen to maintain a fame that reaches beyond the borders of our own special district (from which we get our name), as it reaches also beyond the boundaries of our still more wondrous county of vale and wold, of forest and estuary, despair is lost in enthusiasm and hope.

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# SOME COTTESWOLD BRACHIOPODA

## (PART II.)

[Plate III.]

BY

**CHARLES UPTON**

(Read March 3rd, 1903)

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In my former paper,[1] I described three new species of Cotteswold Brachiopoda, and referred to a number of other recognised forms which had not previously been recorded as occurring in the Cotteswold district. The present paper will be on the same lines as the former, and may be considered a continuation of it.

Of the Brachiopoda from the Secondary Rocks, the *Rhynchonellæ* are admittedly the most difficult to determine. The genus is represented in the Pea-Grit by a multitude of specimens, the majority of which have been identified with *Rhynchonella subangulata*, Davidson. I have, however, for a long time been convinced that all the forms which had been grouped with that species did not really belong to it, although I was unable to discover any authority for separating them.

In the course of my researches a large number of specimens have passed through my hands, and the conviction has been forced upon me that, in addition to the true

1 Proc. Cotteswold Nat. F. C., Vol. xiii., pt. 2 (1899), p. 121.

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*R. subangulata*, as described by Dr T. Davidson, and figured by him,[1] there are at least two other well-defined species, which I will now describe.

1. RHYNCHONELLA GRANULATA, sp. nov.

Pl. III., figs. 1—6.

DIAGNOSIS.—Shell of medium size, somewhat triangular, usually wider than long; valves moderately convex; the convexity of the brachial valve exceeding that of the pedicle valve, umbo prominent; distinctly trilobed, central lobe considerably elevated with a correspondingly deep sinus in the pedicle valve; beak acute, slightly incurved; beak ridges sub-acute, forming considerable false areas; foramen small, circular, margined, complete, separated from the umbo by well-displayed deltidial plates; ribs prominent, angular, extending the entire length of shell, usually from sixteen to eighteen in number, of which four or five occupy the mesial fold; flanks of the ribs covered by innumerable small granules. The valves meet in front at an acute angle, but at maturity become thickened by the addition of numerous parallel layers of shell on the inner margins.

Three specimens measure as follows:—

| | | | |
|---|---|---|---|
| Length... | 18 mm. | 16 mm. | 19 mm. |
| Width ... | 21 mm. | 21 mm. | 19 mm. |
| Height ... | 13 mm. | 12 mm. | 12 mm. |

A more globose variety occurs having more numerous ribs and a less defined mesial fold.

Dr Haas, in his monograph on the *Rhynchonellæ* of the Jura formation of Elsass-Lothringen, pl. 5 fig. 3, figures a specimen of that genus from the Murchisonaeschichten of St Quentin bei Metz as *R.* cf. *angulata* (Sowerby), which may be the same shell, but in the specimen figured the foramen is incomplete.

*R. granulata* differs from *R. subangulata* in having a granular surface to the valves, in the continuous convexity

1 Suppl. Brit. Juras. Brach. (Pal. Soc.), Vol. iv., p. 208, pl. xxix., figs. 14-16.

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of the brachial valve, which in *R. subangulata* is convex from the umbo to about half its length, whence it usually becomes slightly concave to the front margin, and in the difference in the manner in which the margins of the valves become thickened in old age. This latter is an extremely well marked feature, and is well shown in Dr Haas' figure.

The fossil is found in the Ferruginous Limestone—Zone of *Tmetoceras scissum*—and throughout the Pea-Grit series, and is common wherever the beds are exposed.[1] It also occurs in a somewhat modified form in the Oolite Marl, from which formation in the Stroud district I have a number of specimens.

2. RHYNCHONELLA BUCKMANI,[2] sp. nov.
Pl. III., figs. 7—9.

DIAGNOSIS.—Shell of medium size, ovate, wider than long, valves very convex, of about equal convexity—brachial valve with a broad but not prominently elevated mesial fold—corresponding sinus in pedicle valve. Beak acute, much incurved, overhung by the very prominent umbo. Foramen elongate, bounded on each side by narrow incomplete deltidial plates, and in front by the umbo. Beak ridges almost wanting. Ribs prominent, angular, extending the entire length of the shell, variable in number from sixteen to twenty, of which from five to six occupy the mesial fold and sinus. The valves meet in front at a very obtuse angle, which in mature specimens becomes obsolete, so that the junction forms an almost continuous curve with the two valves.

The large specimens measure :—

| | | | |
|---|---|---|---|
| Length... | 17 mm. | 17 mm. | 16 mm. |
| Width ... | 19 mm. | 20 mm. | 18 mm. |
| Height... | 15 mm. | 14 mm. | 13 mm. |

1 See Mr L. Richardson, "Handbook Geol. Cheltenham" (1904), p. 77 (footnote), and p. 243.

2 In honour of our late Honorary Secretary, Mr S. S. Buckman.

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The shell is quite different in shape from both *R. subanglata* and *R. granulata*, being more globose than either. It differs from the former in not having the very elevated front of that species, and from the latter in the lack of dermal granulation, and in the incompleteness of the foramen.

*R. Buckmani* occurs from the base of the Pea-Grit, where it is rather small up to and in the coral-bed, which between Stroud and Leckhampton lies immediately upon the Pea-Grit.[1] I have found it at various localities in the Stroud district.

The shell is not very dissimilar from some specimens of *R. subobsoleta*, and is quite possibly the ancestral form of that species.

In my former paper I referred very briefly to the mode of development of the shells of the *Terebratulæ*, the primitive type being devoid of frontal folds followed by a form having a simple elevated fold, and later by greater complexity.

Mr Buckman has in the Club Proceedings[2] figured and described three specimens by the name of *Terebratula withingtonensis*, which illustrate this feature.[3]

The fossil figured by Mr Buckman is not uncommon in the lower part of the Pea-Grit in some localities.

Brachiopods are remarkably scarce in the Lower *Trigonia*-Grit, but that formation at the Frith, near Stroud, has yielded me a considerable number of specimens of various forms, among them being one to which a somewhat special interest attaches on account of its further illustrating the point raised. The shell is in shape very

1 "Handbook Geol. Cheltenham," p. 243.

2 Proceedings, Vol. xiii. (1901), p. 231, pl. xii. figs. 8-12.

3 For fuller information with regard to the development of the shells of the Brachiopoda, see papers by the late Dr Beecher on "Development of the Brachiopoda," American Journal of Science, Vol. xli, (1891), p. 343, and Vol. xliv. (1892), p. 133; and by Mr Buckman, "Bajocian of the Mid Cotteswolds," Quart. Jour. Geol, Soc., Vol. li. (1895).

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like the normal form of *Ter. withingtonensis* (fig. 8 Buckm.) the chief distinction being that the line of junction of the valves, when viewed laterally, describes a continuous curve from the beak of the frontal margin, whereas in *Ter. withingtonensis* it is a sigmoidal curve, often markedly so.

So long a period elapsed between the time of the existence of Mr Buckman's species and that under notice that I do not feel justified in referring it to his species; moreover, I do not look upon the shell as belonging to a type which had during that lapse of time maintained its form without material modification, but as a degenerate form—its degeneration being probably due to unfavourable environment. I do not know what the immediate ancestor was, but I suggest that it is not unlikely to have been *Ter. notgroviensis*, S. Buckm. I propose to call it *Ter. degenerata*.

3. TEREBRATULA DEGENERATA, sp. nov.

Pl. III., figs. 11—13.

DIAGNOSIS.—Shell small, almost circular, slightly longer than wide, uniplicate, the fold rising gradually from the extreme lateral margins of the valves, valves about equally convex, moderately inflated, beak very short; foramen large, extending almost to the umbo, deltidial plates very small.

I have found the shell in the Lower *Trigonia*-Grit at the Frith, near Stroud, where the form appears to be constant. A more elongate, but in other respects similar shell occurs sparingly in the same beds at Ravensgate Hill and Leckhampton Hill.[1]

There are a number of well recognised uniplicate *Terebratulæ* in the Inferior Oolite, *e.g.*, *T. Etheridgei*, Dav., *T. withingtonensis* S. Buckm., *T. Buckmani* Dav., and

1 "Handbook Geol. Cheltenham" (1904), pp. 77, 104.

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*T. Wrighti* Dav., but a person moderately well acquainted with the Jurassic Brachiopoda would not, I think, confound *T. degenerata* with any of them.

4. AULACOTHYRIS ALVEATA, *Quenstedt.?*

Pl. III., figs. 14—19.

1871. TEREBRATULA CARINATA ALVEATA, *Quenstedt.* Die. Brach. p. 349, pl. xlvii., figs. 47—50.

In the upper portion of the Lower Limestone (belonging to the Pea-Grit series) there occurs somewhat sparingly a form of *Waldheimia (Aulacothyris)* which does not appear to have been noticed by Dr Davidson. The shell is a very striking one, strongly resembling the well-known *A. carinata* of the Ragstones. The brachial valve has a broad and deep furrow throughout its length, and the pedicle valve is strongly carinate. Mr Buckman suggests that it may be the same shell as that which Quenstedt figures and describes as *Ter. carinata alveata* in the work above referred to, and I accept that identification; but in accordance with the modern system of nomenclature the specific name "*alveata*" can alone be retained. The generic name also must be abandoned, as the fossil does not belong to the group now distinguished by the name *Terebratula*. It has been recorded by Mr Richardson from the Pea-Grit,[1] and I have obtained specimens from Kimsbury Castle (Painswick Hill), Crickley and Leckhampton Hills.

The shell is probably a development of the small, almost circular *Aulacothyris Blakei*, Walker, which occurs in the *Opalinum*-Zone: indeed, young specimens of *A. alveata* are scarcely distinguishable from *A. Blakei*.[2]

The specimens figured are from the upper portion of the Lower Limestone of Crickley Hill.

1 "Handbook Geol. Cheltenham" (1904), p. 243.

2 Specimens of *A. Blakei* sometimes occur much larger than those figured by Dr Davidson, which are immature.

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## 5. TEREBRATULA MUTILATA, sp. nov.

Pl. III., figs. 20—23.

1878. TER. SPHÆROIDALIS VAR. ? *Dav.* Supp. Brit. Oolitic and Liassic Brach. (Pal. Soc.), pl. xviii., fig. 15.

DIAGNOSIS.—Shell of medium size, pyriform, valves of about equal convexity with a single rounded frontal fold. Beak truncated by fracture or abrasion during life and replaced by a shelly plate and small circular false foramen very slightly separated from the umbo. Deltidial plates entirely wanting.

Dr Davidson, in his Supplement to his monograph, figures a globose *Terebratula* from the "Oolitic Marl, Inferior Oolite, Crickley Hill." I have three examples which somewhat resemble the specimen figured, but are smaller. All my specimens are from the Oolite Marl, or Upper Freestone, two of them from the Firth, near Stroud, and one from Crickley. Mr L. Richardson has shown me another specimen which he obtained at Leckhampton.[1]

A singular feature about two of my specimens, which is also shared by Mr Richardson's, is that the beaks have the appearance of having been broken off during life, and the large orifice made by the fracture repaired by the addition of a plate of shelly matter perforated near the umbo for the protusion of the anchoring ligament. The other shell has unfortunately suffered from *post mortem* truncation of the beak, so that it cannot be determined with certainty if the apparent mutilation is a specific character, and I know of no other specimens.

The discarding of portions of shell which have become useless to the inhabitant is a common feature among

1 Referred to by Mr Richardson in his "Handbook" as "*T. sphæroidalis*, var., Davidson," p. 246.

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gasteropods, and in a lesser degree among lamellibranchs, but I am not aware of any instances among the Brachiopoda, unless indeed the closing up in old age of the pedicle passage in some of the palæozoic forms can be so described.

The beak of *Eudesia cardium*, Lam, has the appearance of having been truncated by abrasion, but in that species no attempt appears to have been made to make good the injury. It is not difficult to conceive that in the case of a Brachiopod having a very short and possibly weak anchoring ligament, wave movement would be liable to cause abrasion of the part of the shell most nearly in contact with the support to which the animal was attached.

NOTE.—At the time of reading the paper I did not propose to name the form, but I have since found two other examples having precisely the same characters, and in response to a suggestion that I should name, describe, and figure it, I have done so.

6. TEREBRATULA VENTRICOSA, *Hartmann*.

Pl. III., figs. 24—26.

1830. T. VENTRICOSA. Zeiten die Versteinerungen Wurtembergs, p. 52, pl. xl., figs. a, b, c.

1862. T. VENTRICOSA *E. Deslongchamps*. Pal. Franc. Brachs., Juras., pl. lxxiii., lxxvi.

1871. T. VENTRICOSA *Quenst*. Die Brachiopoden, pl. xlix., fig. 102.

In the supplement to the British Liassic and Triassic Brachiopoda, vol. iv., pl. xv., figures 10 and 11, Dr Davidson figures two shells belonging to Mr John F. Walker's collection as *T. ventricosa*, but with a query. One (fig. 10) is stated to be from the "Inferior Oolite" of Cleeve Hill, the other (fig. 11) from the Pea-Grit of Crickley,[1] but

1 Specimens from this horizon are recorded in "Handbook Geol. Cheltenham," p. 246 as "*T. ventricosa ?* Davidson (non Zeiten.)"



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a comparison of the figures given by Dr Davidson with Zeiten's above mentioned leaves me with a considerable outstanding doubt as to the correctness of the identification. The fossil which is figured by Dr Davidson appears to be a form not uncommon in the upper portion of the Lower Limestone, immediately below the pisolite of Crickley, of which I have a considerable number.

Whether my doubt is well founded or not, it is a pleasure to be able to record the finding of two specimens in the Cotteswolds, which I venture to say admit of little or no doubt. Both specimens are from the lower portion of the *Phillipsiana*-Beds (*Sauzei*-Zone) of Cleeve Hill, agreeing in respect of horizon with Dorset specimens as recorded by Mr S. S. Buckman.[1] The Cleeve Hill fossils agree almost exactly with the nonplicate specimens figured by E. Deslongchamps, and also with the one figured by Quenstedt.

A complete specimen measures in length 49 mm., in breadth 37 mm., and in thickness 26 mm.

7. THECIDELLA GRANULOSUM, *Moore*.

1854. Proc. Somerset Arch. and Nat. Hist. Soc., p. 117, pl. ii., figs. 1—6.
1876. Dav. Supp. Brit. Lias. and Trias. Brach., Vol. iv., pl. xii., figs. 1—6.

8. ZELLANIA DAVIDSONI, *Moore*.

1854. Proc. Somerset Arch. and Nat. Hist. Soc., p. 112, pl. i., figs. 1—3.
1876. Dav. Supp., pl. xi., figs. 18, 19.

9. CRANIA SAUNDERSII, *Moore*.

1861. Geologist, Vol. iv., p. 98, pl. ii., figs. 11, 12.
1876. Dav. Supp., pl. ix., figs. 38, 39.

1 Quart. Journ. Geol. Soc., Vol. xlix. (1898), p. 498.

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Many of the small cavities occurring in the Coral bed which lies upon the Pea-Grit at the Frith are filled in with a yellow marly material, in places quite soft, and containing immense numbers of minute fossils. Amongst the micro-brachiopods there are a great number of specimens of the above three forms, together with many others, several of which appear to be as yet undescribed.

The three species of brachiopods referred to were described by the late Charles Moore from specimens found at Dundry, where they appear to be not uncommon, but hitherto they have not been recorded from the Cotteswolds.

Dr Davidson's figures are copied from the original illustrations in the Proceedings of the Somersetshire Archæological and Natural History Society. In the case of the *Thec. granulosum*, the supramembraneal disc is shown to be imperforate, but judging from my own specimens I should imagine that this is due to a deposit of calcareous matter in the process of fossilization, and that during the lifetime of the organism the disc did not consist of a continuous layer of shell. In my own specimens in all cases in which the disc is retained it is perforated somewhat after the fashion of a calcareous sponge.

*Crania Saundersii*, as figured in the monograph, would appear to be drawn from immature specimens, as my own examples—assuming that my identification is correct—go to show that at maturity the shells become imbricated.

Speaking generally, the Cotteswold specimens of these small shells appear to be better preserved and wash out more cleanly than the Dundry specimens.

NOTE.—Since the paper was read I have seen Mr Moore's paper in the Geologist for 1861, and I find that he states on p. 98 that *Crania Saundersii* occurs in the Inferior Oolite of Minchinhampton. The record is therefore not new.



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## EXPLANATION OF PLATE III.

Figs. 1—3. RHYNCHONELLA GRANULATA, sp. nov.
Lower Limestone (Pea-Grit), Crickley Hill, near Cheltenham.

Figs. 4—6. *Ibid.* (globose variety.)
Pea-Grit, Randwick, near Stroud.

Figs. 7—9. RHYNCHONELLA BUCKMANI, sp. nov.
Pea-Grit, Randwick, near Stroud.

Fig. 10. RHYNCHONELLA SUBANGULATA, *Davidson*.
Front view, for comparison with Figs. 3, 6 and 9.

Figs. 11—13. TEREBRATULA DEGENERATA, sp. nov.
Lower *Trigonia*-Grit, The Frith, near Stroud.

Figs. 14—19. AULACOTHYRIS ALVEATA ? *Quenstedt*.
Lower Limestone (Base of Pea-Grit), Crickley Hill.

Figs. 20—22. TEREBRATULA MUTILATA, sp. nov.
Top of Lower Freestone (Oolite Marl), near Crickley.

Fig. 23. *Ibid.* Dorsal view of another specimen from the same locality.

Figs. 24—26. TEREBRATULA VENTRICOSA, *Hartmann*.
*Phillipsiana*-Beds (*Sanzei*-Zone), Rolling Bank Quarry, Cleeve Hill, near Cheltenham.

All the specimens are in the Author's collection.

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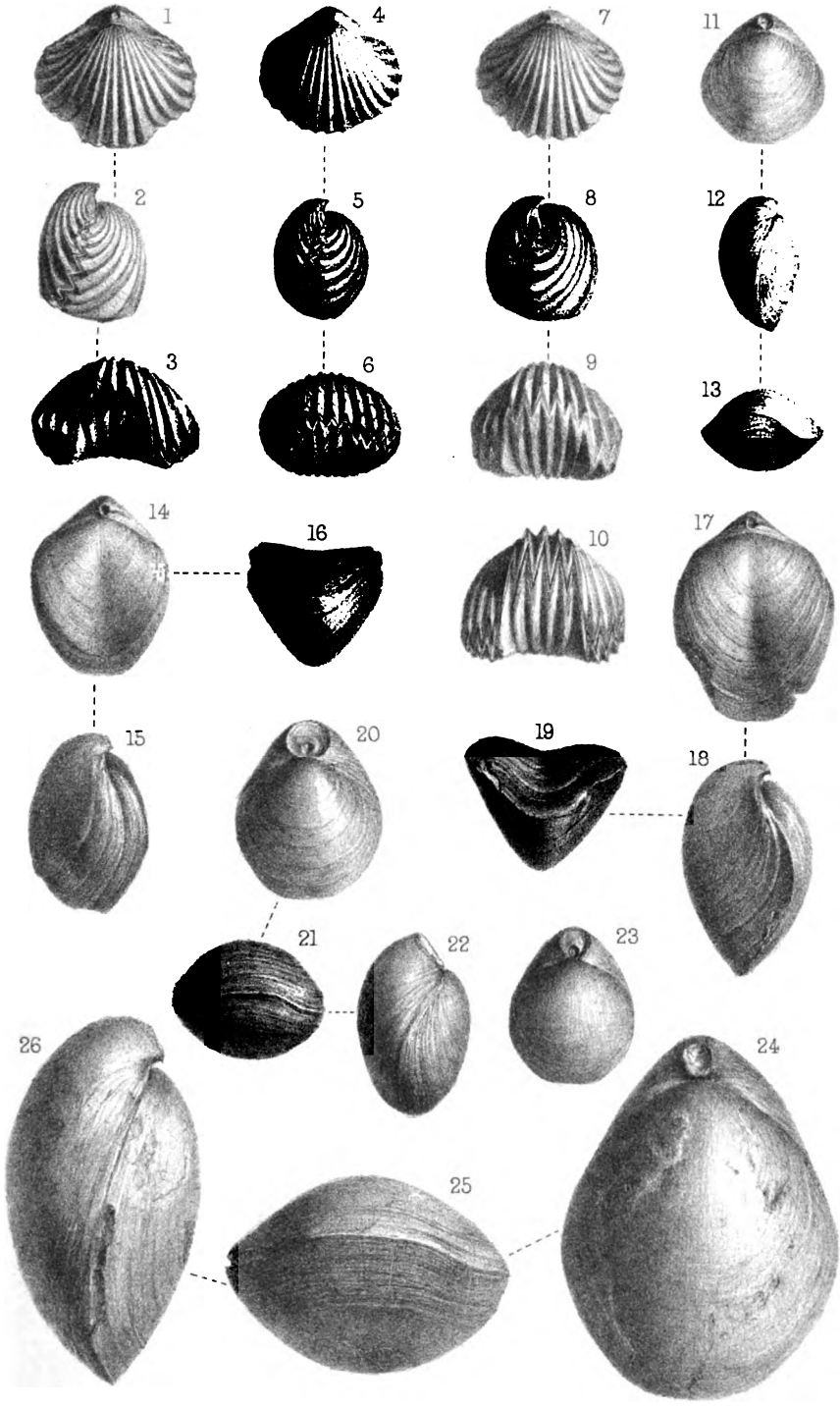


F. H. Michael del. et lith.

West, Newman imp.

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# THE EFFECTS OF EARTH-PRESSURES ON THE KEUPER ROCKS OF THE ELDERSFIELD DISTRICT

BY

L. RICHARDSON, F.G.S.

(Read at Eldersfield, June 14th, 1904.)

The red marls and sandstones of the Eldersfield district belong to the Keuper Series. They were deposited in an inland sea, the waters of which washed the eastern slopes of the Malvern Hills. At times, owing to excessive evaporation, the waters of this inland sea shrunk considerably, leaving flats of marl which dried and cracked under the rays of a tropical sun. The land around the sea was arid; few forms of plant-life could exist; and few animals trod the shores or uplands. Life in the sea was equally scarce, and this may have been due to two causes, the extreme saltness of the waters, and the presence of an excessive amount of iron. A few forms of life, however, did seem to inhabit the sea, because as soon as ever conditions were a little more favourable (that would be as soon as the water was a little fresher) there are found in the deposit which was laid down during the rainy period, fish-, plant-, and crustacean-remains. The deposit

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formed under these conditions is the sandstone-bed known as the Upper Keuper Sandstone, a stratum well-developed in this neighbourhood. Then conditions changed; causing a cessation of the deposition of arenaceous matter, and the accumulation of marl again. But after about 215 feet of this rock had been formed the waters were again reduced by evaporation, and the inland-sea was probably reduced to slowly-shrinking lakes surrounded by flats of Keuper Marl. Such then was the scene at the close of Keuper times: dry flats of marl and a few lakes. Then earth-movements caused depression in the south-east and a slight rise in the west and north-west. Concerning these earth-movements much cannot be said at present: it may be suggested that the effects were analogous to those of which there is unmistakable evidence in the rocks so well exposed in the Cotteswold Range—the Inferior Oolite. In these rocks there is evidence of repeated movements of the sea-floor while they were being deposited, and the results of these movements were such as to bend the strata into anticlines and synclines: not like those which are seen in districts composed of Palæozoic Rocks; but flexures of which a synclinal area extends over miles. For example, near the Rising-Sun Hotel, on Cleeve Hill, is a synclinal axis, but the anticline is not reached until Birdlip. Producing these axes in the required directions, the synclinal one will pass near Dunhampstead, not far from Droitwich; while the anticlinal one runs in the direction of Lassington, near Gloucester.

Earth-movements may have affected the Keuper deposits in this way just before the Rhætic Epoch, and thrown them into slight anticlines and synclines; and the same movements may have admitted the Rhætic ocean in the south-east.

Now it has been shown that the lowest bed in the Rhætic Series so constant over large areas is the stratum

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which at Aust, Garden, and Wainlode Cliffs, happens to be full of vertebrate-remains—the well-known Bone-bed.[1] But in Worcestershire the equivalent stratum is usually a thick deposit of sandstone.[2] Near Defford, and again at Abbotts Lench, however, an ossiferous development has been noticed. But the reason why the sandstone-deposit, usually without vertebrate-remains, is known to be on the same horizon as the well-known Bone-bed of Garden and Wainlode Cliffs is, because at Wainlode Cliff the one variety may be traced laterally into the other.

Above this Bone-bed or its equivalent the remaining Rhætic deposits are remarkably persistent; allowing, of course, for unequal deposition. But such is not the case with those below. The Rhætic Series in this country seldom exceeds 35 feet in thickness, a fact which should be remembered, because six or seven feet is then a fair fraction of the whole. Now at Dunhampstead there is a deposit over four feet thick below the Bone-bed-equivalent; at Wainlode Cliff, two feet; at Denny Hill, nothing; at Chaxhill, over seven feet. At Chaxhill and Garden Cliff are beds not found elsewhere in Gloucestershire and Worcestershire; if the depression of the floor of the Rhætic Ocean had been sufficient at Dunhampstead, the sequence would probably have been the same as that now seen at Garden Cliff; since the upper of what are frequently termed the "*Pullastra*-sandstones" is present in the railway-cutting and also in the Crowle section. Therefore the theory advanced to account for these phenomena is that the Keuper Marls were bent into slight anticlines and synclines in immediate pre-Rhætic times: in the synclinal areas the earlier Rhætic beds were laid down, and then there was successive overlap of the deposits on the marls. The greatest overlap occurred when the

1 Proc. Cotteswold Nat. F. C., Vol. xiv., pt, 2, pp. 127-174; pt. 3, pp. 251-256; Geol. Mag., 1903, pp. 80-82.

2 Proc. Cotteswold Nat. F C., Vol. xv., pt. 1, pp. 19-44.

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Bone-bed was formed. Where it rested upon the Keuper Marls, masses of that rock were derived, rolled, and included in the bed, while in other places the vertebrate-remains were washed into cracks in the marls. But in those areas where lakes existed at the time the Rhætic Ocean gained access to the British inland-sea, there, and there only, is the sequence complete from the one series to the other. In such cases an admixture of sediment would be probable, such as is the case at Penarth.

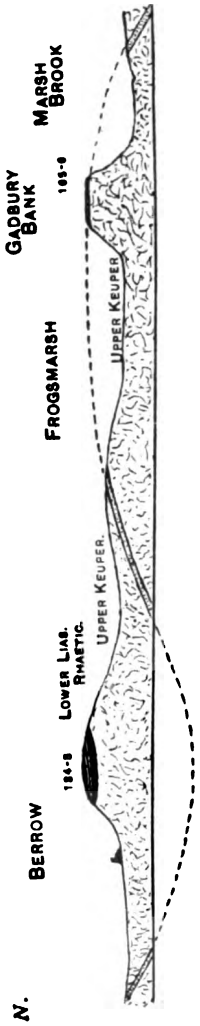

Fig. 1.—Section from Berrow to Gadbury Bank.

The reason why the subject of the pre-Rhætic flexuring has been entered into somewhat fully is to show that it is highly probable that earth-movements were at work very early in the Mesozoic Era, causing flexures so as to suggest that the forces acted from north-east and south-west.

Above the Rhætic Rocks, as will be seen upon referring to figure 1, is the Lower Lias, which caps Berrow Hill. Now since there are unmistakable signs of earth-movements (the effects of which were to bend the strata into slight anticlines and synclines, in the epoch during which the Inferior Oolite was deposited), and there are also suggestions of analogous phenomena in immediate pre-Rhætic times, it will be seen that the Keuper Rocks must be much affected, for they have been disturbed by every movement since their formation. And with a range of hills composed of Archæan Rocks, such as the Malverns,

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close at hand, acting as a line of resistance, it follows that in such districts they would be more than usually bent. With the main force acting from the north-east, the greatest flexuring would be a little to the south-east of the Malvern Hills. Such is the case: the Keuper sandstone of this neighbourhood has been remarkably bent about, as a reference to the Geological Survey-Map (sheet 43, N.E.) and the accompanying sections show at a glance.

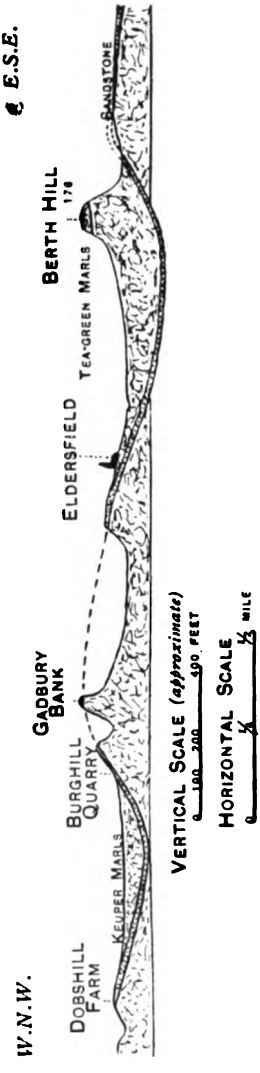


Fig. 2.—Section nearly at right-angles to that given in Fig. 1.

Between Limbury Hill and Staunton the sandstone dips to the east, and just over a mile in that direction the escarpment of the Lias runs almost parallel with it. There is a good section showing the dip of the deposit in a quarry by the side of the road from Upleadon to Oridge Street, on the top of the hill near the farm. But at Eldersfield there is a denuded dome of sandstone of which the centre remains, forming a capping to Gadbury Bank; while on all sides except the south the outcrop of the rock constitutes a conspicuous feature. The numerous sections show that the dip is *qua-qua-versal*: the rock slopes away in all directions from that central boss. In a lane-cutting at Eldersfield, near the Church, the sandstone is seen dipping in a direction a little north of east at an angle of about 8°.

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At Eldersfield, then, in times past, was a complete ellipsoidal dome: but the sandstone has been so denuded as to leave a central boss, with the encircling outcrop of the main sandstone-mass at distances varying from under a quarter to over three-quarters of a mile away. As section 2 shows, there is a syncline to the west; the sandstone is seen dipping west in the Burghill Quarry, but at Dobshill Farm (where it is finely exposed in a road-cutting) east. The depression of the sandstone, however, is not very great, as that rock comes to the surface at Cromer Farm, a little to the north: indeed, the distribution of the bed between Dobshill on the west, Burghill on the east, and Cromer Farm on the north, is in the form of a semi-ellipsoidal basin. Proceeding eastwards from Eldersfield, a synclinal district is at once entered, and the area of maximum depression is a little to the east of a point half-way between the respective outcrops, and near Berth Hill. Concerning this conspicuous eminence, the writer recently found an interesting statement in the minute-book of the Club. It was as follows:—"Berth Hill, near Eldersfield, is an example of an outlier where the Lower Lias is gone, but only just gone, and some black Rhætic shales are left there just in sufficient quantity to nourish certain wild-flowers, such as *Chlora perfoliata*, *Iris fœtidissima*, and the Bee Orchis, which love the Lias clays, but do not grow well or flourish luxuriantly on the Keuper Marls below." Several small excavations made on this hill failed to reveal any black shales, but there was abundant evidence of a greenish marl. There is no reason, however, to doubt in the least the accuracy of the Rev. W. S. Symonds' discovery, as of course it is just what would be expected, for the hill is situated on the same synclinal axis as Berrow Hill, which is capped with higher beds than the Rhætic—the *Ostrea*-beds of the Lower Lias. In a field on the south side of the road between Hillfield

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House and Westend Cottage is evidence of the sandstone, and according to the geologic structure of the district it must rise at a comparatively high angle. The line of section (fig. 2) then traverses the southern extremity of a contorted anticline. The strike thence is a compressed semicircle, the main axis of the plication being, relative to the outcrops on the east and west, slightly excentral in a westerly direction. To the north of Drinkers'-end[1] the domical area expands, and the two outcrops are farthest apart to the east and west of Hardwick Court. The respective outcrops would seem to indicate that after one force had imparted a domical form to the sandstone, another acting from the north-east compressed it. At Langdon Meadows the anticlinal axis just described is joined by another coming from the west. Owing to the combination of these two axes of elevation, the respective outcrops of the sandstone are brought near together at Langdon Hill End: the anticlinal distribution of the deposit then apparently ceases, and the sandstone pursues a normal course from Severn-Stoke northwards with regard to its relationship to the Lias. The district between the two areas of elevation at Eldersfield and Langdon Meadows respectively, is naturally depressed, and the earth-movements have so acted as to produce an almost complete basin, in the centre of which is situated Berrow Hill. The arrows on the Geological Survey-Map indicating the dip of the sandstone around the Berrow outlier show clearly the inclination of the bed at the various localities, and it will be observed that the phenomenon is just the reverse of that which occurs to the south: at Eldersfield is a roughly ellipsoidal dome;

1 There are several sections of the Keuper deposits between Drinkers'-end and Longdon. In a road-cutting east of Nashend grey arenaceous marls are exposed resting upon red marls. Newbarn is an interesting locality under half-a-mile to the north of the last section, where the Keuper Sandstone is well exposed. The sandstone may also be studied near Hill Court Farm (where there is also a fair section of the subjacent Keuper Marls); and at the cross-roads about three-quarters of a mile to the north again.

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at Berrow an almost perfect basin. The Lower-Lias limestones forming this outlier have been much quarried in the past. There are two sections available at the present time, identical as regards the sequence of the beds; and perfectly normal as regards lithic structure.

Although all the newer solid deposits have been denuded from the Eldersfield district, we know—as has already been pointed out—that at various times whilst the Inferior Oolite was in the course of formation, earth-movements occurred which compressed the strata, throwing them into little anticlines and synclines. And the Keuper beds must have been affected by these earth-movements also: indeed by every one which has occurred in this district since they were formed. No wonder, then, that the Keuper deposits have been thrown into the anticlines and synclines depicted in the accompanying sections.

Lastly, it may be pointed out that not only have the earth-movements in the past been the cause of physical features of much beauty at the present day, but the flexuring of the sandstone has been most important from an economic standpoint. This deposit constitutes a water-bearing bed: many of the principal farmhouses in the district are situated on or near its outcrop, or it can be reached by wells. Since the bed is so frequently at the surface it has been possible to quarry in many places, and Eldersfield and Pendock[1] Churches, and many of the buildings in Longdon, and isolated farms, have been constructed with this stone.

1 The hollows near this Church are all that remain to indicate the site of the once celebrated Pendock Quarries, where the Keuper Sandstone was largely worked. This sandstone contained extremely well-preserved examples of *Estheria minuta*, and near the base a bone-bed, two inches thick, which yielded to the Rev. W. S. Symonds fragments of ichthyodorulites, fish-teeth (*Acrodus*), and bones. See Quart. Journ. Geol, Soc., Vol. xi. (1855), pp. 450, 451.

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# NOTES ON ROCKS COLLECTED IN CYPRUS

(Read November 8th, 1904.)

## I.—DESCRIPTION OF THE LOCALITY.

By J. C. DUKE, Lieut.-Col.

These rock-specimens were brought from the southern slopes of the western end of the Troödos Range in Cyprus. This range extends along the south of the island, having a length of about 55 miles, and a mean breadth of 15 miles.

The crest-line of the mass being at an average distance of 15 miles from the coast-line, and the mean height of the range being some 5000 feet, the ascent is markedly steep, especially on nearing the summits.

The mass of the range consists of plutonic rocks: limestones are overlying up to a height of 2500 feet.

The sides of the range are deeply seamed with clefts and ravines, and great weathering action must take place. Snow, too, lies on all elevations over 4000 feet.

From November to March the stream beds are filled the whole length of their course with water-worn boulders derived from the higher levels. The limestones, exposed in small cliffs in the river banks, &c., showed no fossils, nor did those of the littoral, which are not nearly so compact in texture.

No traces of active volcanic action exist. Basalt, much disintegrated, may be seen on some of the spurs of the

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Troödos range (e.g., Platraes, 4000 feet): such localities affording facilities for vine cultivation.

## II.—Notes on the Specimens.

**By C. CALLAWAY, D. Sc., F. G. S.**

The most abundant rock in Col. Duke's collection is a granitoid igneous plutonic variety called gabbro. It consists of diallage and felspar in conspicuous crystals. Diallage is a dark-green silicate of magnesium and iron, and belongs to the augite family of minerals. The felspar is probably a member of the soda-lime group. It is partially decomposed into a white opaque substance. Some of the specimens of gabbro are crushed and altered.

Steatite (soap-stone) comes next in abundance. It is pale-green, unctuous to the touch, sometimes schistose, and is well known as one of the softest minerals. Its composition is silica, magnesia, water, and a little iron-oxide. In smaller proportion than the steatite are serpentine and chrysotile. Both of these are hydrous silicates of magnesia, the former being massive in structure, the latter fibrous, like asbestus. Iron-ore is also present, and limonite, a hydrated iron-oxide.

The relations between the gabbro and the minerals of the steatite group are not known, as no field evidence is available. As a speculation, it is suggested that the latter are derived from the diallage by decomposition in the presence of water. The iron-oxides may also have had the same origin. One of the most common cases of alteration in rocks is the decomposition of silicates of magnesia and iron. It is supposed that the rock is permeated with carbonated water, which decomposes the silicates, producing soft green hydrous silicates of magnesia (such as steatite, serpentine and chlorite), and

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iron-oxides (as magnesite, hæmatite, and limonite), while the silica is liberated as quartz. Some of these alterations may be seen in the specimens before us, notably the change to iron-oxide, some of the crystals of diallage having their centres converted into that substance. By these decompositions great changes have been produced in the earth's crust, basic igneous rocks being transformed in mass into crystalline schist and iron-ores. Similar alterations have taken place in the ancient rocks of the Malvern Hills, as I described in outline to the Club in 1898.[1]

Some of the specimens show a laminated structure, serpentine and steatite being arranged in alternating layers. This effect would be ordinarily produced if the decomposition took place under pressure, the new minerals, as they were generated, being squeezed out into laminæ. This structure led the old school of geologists to assign a sedimentary origin to many igneous rocks. It was perhaps this laminated or schistose appearance that suggested to Capt. A. R. Saville, in his Report on Cyprus, that the gabbro was produced from stratified deposits by a process of metamorphism. This, as I have attempted to show, is a misapprehension of what has actually occurred.

The rocks of Cyprus have been recently described in a paper read before the Geological Society of London by Mr C. V. Bellamy, assisted by Mr A. J. Jukes-Browne.[2] Mr Bellamy refers to the plutonic masses, and considers that they have been intruded into the sedimentary strata of the island in the interval between the Oligocene and the Pliocene periods. Assuming the accuracy of this observation, it is interesting to notice so many points of resemblance between rocks comparatively so modern and the ancient crystallines of Malvern.

1 Proc. Cotteswold Nat. F. C., Vol. xii., p. 239. 2 Proc. Geol. Soc., Session 1904-1905, p. 29.

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# KOREA

BY

W. R. CARLES, C.M.G., F.L.S., F.R.G.S.

(Read December 6th, 1904.)

The area of Korea is a little larger than that of England, Scotland and Wales, and its extreme length from north to south is about 600 miles. The east coast is somewhat destitute of harbours, with the exception of Broughton Bay, which is a fine sheltered position, and the tide has a rise and fall of only a few inches. The west coast and the south are much broken into by inlets and arms of the sea. Fusan and Masanpo on the south, Mokpo and Keumsan in the south-west, Chemulpo, Chenampo, and Yongampo on the north-west, are all capable of development. But enormous mud-flats, extending far out into the shallow Yellow Sea, prejudice Chemulpo, which is also handicapped by a 36-foot rise and fall of tide.

The whole country is mountainous, especially in the northern half. The east coast is fringed by a range of mountains, which leave but a few miles of lowlands between their steep face and the sea. On the west and south the mountains descend more gradually, and allow of a succession of beautiful valleys, cut by rivers, many of which are navigable for some little distance. But the only great river of the country is the Yalu or Amnok. This forms the frontier between China and Korea. On



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the east the frontier-line is completed by the Tumen River, the left bank of which, for the last eight miles, is Russian territory.

In all maps of Korea a mountain range is figured as forming a continuous line along the east coast. I am inclined to believe that further exploration will show that this is not the case, but that the mountains in Korea, as in China, and the island of Kiu Siu, have a general south-west and north-east direction, and that instead of the mountains in the south-east of Korea having a south-east and north-west direction, they are composed of a number of parallel chains, whose direction is south-west to north-east.

Mr Rein, in his excellent work on Japan, says that "three groups of rocks considerably predominate in Japan, viz., Plutonic rocks, especially granite; Volcanic rocks, principally trachyte or dolerite; and Palæozoic schists; while on the other hand lime and sandstone, especially of the Mesozoic strata, are strikingly deficient. Often the old crystalline rocks are for long distances overlaid by very old schists and quartzite. Their strike in general follows the main direction of the islands from south-west to north-east. This older range reaches on the average a height of 1000-1200 mètres, and exceptionally of 2000 mètres and upwards. In some districts Mesozoic sand and limestone are found in connection with it. * * Volcanic masses break through and overlay all these rocks, and deposits exist in innumerable places. Often they fill up gaps between them, and appear to prevail for long distances, though frequently they form only the higher summits in the older mountains.

The basis of the island (Kiu Siu) consists of granite, syenite, diorite, diabase and related kinds of rock. Now the granite, continuing for long distances, forms the prevailing rock; then again it forms the foundation for thick strata of schist and sandstone."

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These remarks might almost equally well have been written on Korea. Granite, gneiss, micaceous schist, porphyry and greenstone are the prevailing rocks. Limestone is rare; the more recent rocks are still rarer. It is only in a few parts, and those of no great extent, that Tertiary rocks were discovered by Dr Gottsche. In his geological map of the country, crystalline rocks are shown as covering at least three-quarters of the whole. Interspersed among them are patches of eruptive rocks, and on the north-west and south-east are considerable beds of Cambrian rock. Only four small fields of Tertiary rock appear, and these all in the northern half of the country.

As is the case on much of the coast of China, the scarcity of lime is greatly felt, and is only in part met by the burning of the shells of oysters and other molluscs which abound on the coast. Chalk, as in China, is unknown; and peat exists only, and that in small quantities and of inferior quality, in the north.

No traces of glacial action have, I believe, been discovered; no active volcanoes remain, but large fields of lava of great depth are found throughout Korea, and extend far into Manchuria.

Of the minerals, gold is found in many places, but, as is the case in North China, the working of it does not appear to be generally remunerative. Mines worked by an American Company paid in dividends last year about £125,000, and other mines in the same province, which are well spoken of, are now being worked by the British-Korean Corporation. But most of the concessions granted to foreigners, though granted on liberal terms, have attracted but little capital. Of the gold exported, the greater part is obtained by the natives at washings, some of them licensed by the Government, and others unlicensed and illegal. The known export exceeds £500,000 annually, and is steadily increasing. There is also much gold which



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leaves the country without being reported to the Customs. For many years the Japanese Mint at Osaka has drawn largely on this source.

Besides gold, there are also galena, copper, coal and plumbago. Very little so far is known regarding the extent and value of these ores. Coal was hardly used in the country until Korea was opened to foreign trade. The occasion for its use which then arose led to its discovery in three or four parts of North Korea, where it has since been worked on a small scale. The large demand for copper for the manufacture of the utensils in brass which are in general use in the country, has not led to any large workings, and veins of copper remain in many places unworked, probably on account of the difficulty encountered in working them by native methods. In the silver mines the same difficulty is encountered, the hardness of the rock occasionally baffling all their efforts, and it seems doubtful whether the yield is sufficient to justify the large expenditure of capital on machinery.

For salt the country is entirely dependent on the pans on the coast, where the salt is obtained by evaporation, apparently by the same methods as are employed on the China coast, north of Shanghai.

The Korean language has the peculiarities of the Altaic or Turanian group. It has no gender of nouns, only one declension, and that formed by invariable *post*-positions. Adjectives are rare, and never declined; a demonstrative adjective takes the place of the third pronoun, and the relative pronoun is replaced by the use of participles. The conjugation of verbs is formed solely by agglutination, and post-positions do not form a part of compound verbs. The construction of the language is said by Professor Parker to be exactly like Japanese. Honorific forms of the conjugation of verbs abound, to indicate the relative rank of the speaker, the person

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addressed, and in some cases the person spoken of. The language is composed partly of words of native origin, but in large measure of words borrowed from Chinese stock, as we have borrowed from Greek and Latin. The pronunciation of these words, borrowed 1000—2000 years ago, has followed absolutely fixed rules, both in Japanese and Korean, and thus they form the best sources from which to learn what ancient Chinese was. Pure Cantonese and the borrowed Chinese words of the Annamese language, confirm these indications in every single point.

Chinese is the written language in general use in records, books, and despatches. When read aloud it is translated into Korean forthwith. The style of composition in Chinese is extremely antiquated, and many of the words bear the meaning, not of to-day, but of 1000 years since. This is the only language which is studied in Korea. The literature, which is extensive and well printed, is all in Chinese. The Korean written language is extremely simple and easy to learn. For this reason it is left to women and children. The only official use of it is in proclamations. The literature is so scanty that it can hardly be said to exist, though there are such things as lending libraries of Korean books. No record exists of the date of its introduction, which is placed by different writers between the fourth and ninth centuries A.D. It consists of eleven vowels and fourteen consonants.

Korea has three religions—Confucianism, Buddhism and Shamanism. In every town the only building which rivals that of the local official is the Confucian Temple. The place is left desolate at all times, except when the annual ceremonies are performed; ordinarily not a single person is seen in the large courtyards which surround the buildings. Buddhism has its Temples—buildings in some cases of great beauty. But in contrast with the Confucian Temples, which strike the eye of the traveller,

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the Buddhist Temples are so hidden away that it is only on leaving the high road and entering the beautiful valleys among the mountains that their existence at all is realised. Shamanism has no Temples or buildings of beauty. Now and again, on the top of a mountain-pass, a humble hut, with one or two attendants, is met with, but the buildings are almost as simple as the offerings, which consist of a rag, a straw shoe, a wisp of straw, a straw rope, a stone, or some other trifle, which, through being offered, has attained a sanctity entirely apart from its value, and in strong contradistinction to its market worth.

Of Confucianism and Buddhism there is little to remark that does not equally apply to China. Confucianism and the worship of ancestors have existed in Korea since its earliest historic times. Buddhism was introduced through China in the fourth century, and has suffered many persecutions, which explain the secluded sites selected for its Temples. Shamanism has existed probably since the earliest ages, and seems to have suffered little change, for the simplicity of its rites hardly admits of change.

Shamanism, as the more interesting and most distinctively Korean of the three religions, is the one of which I propose to say the most. In a paper by the Rev. G. H. James, which appears in the Korea Branch of the Royal Antiquarian Society, 1901, there is more detail furnished than I have met with elsewhere, and much matter which has been learnt long since the date when I left the country, when foreign intercourse was still too recent to allow of any intimate acquaintance with the subject.

Even now Mr James does not attempt to classify the gods further than to throw them into various groups, such as those of the village, the house, the land, and the mountain. Among the first are found five Generals, who rule different quarters of the sky, and their lieutenants,

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80,000 in number, each at the head of a large host, who obey their commands. These spirits seem to stand apart from the rest in that among them are various grades of rank. The spirits of the house, the land, the mountains and other places are apparently independent of each other, and are not subordinate, some to others.

The fetish of the village gods is a group of posts rudely carved and painted to represent human beings. These posts are frequently found at the entrance to a village, and each year receive an offering of rice, dough and fruits.

The mountain gods have shrines erected to them by the side of streams, trees, or large rocks. These shrines are of the simplest character, often only a few feet high, with rough roofs of straw on a few small posts. Sometimes the spirit is represented in the picture of an old man sitting on a tiger; occasionally it is a woman surrounded by her servants.

The cairns, which are constantly found at the head of passes and under trees, are not to one spirit only, but to all the local gods. The stones are of small size, and no passer-by fails to add to the heap. On the branches of the tree are scraps of paper, cast-off clothes, locks of hair and utensils. The gods to whom they are erected are "the most important factors in the work of Korean Shamanism." The offerings are generally of food, presented with prostrations and prayer. A curious feature of the worship is that it is customary to expectorate in front of the altar. This is not done as an insult, but it is in some way connected with superstitions about snakes, of which Koreans stand in great awe. Mr James suggests that the expectoration is intended to give any snake spirit that may occupy the cairn subject matter to occupy him until the traveller has passed by.

Besides these there are the earth spirits, which occupy groves—the Guardian Spirits of the village—goblins and

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demons innumerable, and the dragon. All of these have their peculiar shrines and offerings. The Korean's house is peopled in its turn by other spirits, *e.g.* the Lord of the Site, Good Fortune, the Messenger, the Gatekeeper, the spirit of Small Pox, of Nativity and others. The most prominent of these house spirits is the Lord of the House. "His fetish is enshrined in the frame of the house as soon as the beams are set up, and from that day he is lord of all who dwell within, and their weal or woe is subject to his whim. His fetish consists of blank sheets of paper and a small bag of rice, which are hung from the ridge beam of the principal room—generally the living room of the house." On the completion of the house a grand ceremony is held by the mudang. "A large sacrifice of food is prepared, and an elaborate ritual gone through until she has worked herself up to the proper pitch of frenzy. She then seizes a wand, which enables her to seek the spirit. When found, he perches on the wand, and drags her back to the fetish, into which she introduces him by violently shaking the stick and beating round about the fetish. He is now supposed to feed on the feast for a time, after which the food is passed out to the assembled guests. The spirit becomes the chief protector of the house, and every inmate lives in constant anxiety of offending him. The children are taught not to tread on the threshold, for that is his neck; and when a meal is eaten in the inner room, all parties are careful so to place their tables that they will not be eating facing the fetish. This would anger him, and cause him to afflict some member of the household."

This description may convey a mistaken idea of grandeur, unless it is read by those who are acquainted with the extreme poverty of the Korean people. In all cases the offerings to the spirits are of the simplest character. In the above case, some sheets of paper and a

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bag of rice are all that are reserved to him. Other spirits receive a wisp of straw, a worn-out sandal or messenger's hat, a bowl of water, a gourd, or some such trifle. It is to the Shamans that payment in money is made, for not only can they avert evil, but also, by their influence, evil spirits can be exorcised, illness can be cured, and good fortune be brought to the house and family.

Though the belief in the power of the Shamans is so great, and fear appears to be the predominating element in all observances paid to the spirits, Mr James, himself a missionary, holds that the Korean people have a religious sense, though it may be on a low plane of exercise. To use his own words :—" They possess a sense of dependence on that which is above and superior to themselves. They look out of themselves in time of need—it may be only into the great blue firmament above, but it is a look of expectation and hope. They firmly believe that the human and divine find a plane of intercommunication and relation. We find everywhere among them an earnest striving of the soul after freedom from annoyance and pain."

With regard to Shamanism, the hold that it has on the people is by no means confined to the poorly educated, and the teaching of Confucius has even less influence in Korea than in China in preventing the people from being guided by mere superstitious fears. The Emperor himself is a very prominent instance. His fears of the ghosts that haunt the Palace, in which his Queen was murdered, led him to build himself another Palace, and his presence in the Palace where the Queen was murdered was due to his having, on the advice of Shamans, removed with his Court from the Palace where he had been attacked by Japanese, and had, with the Queen, narrowly escaped from death.

In China the site of houses and graves is selected by the fortune teller. In Korea the position of cities also

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is dependent upon them, and strikingly picturesque is the position generally selected.

The tragedies which frequently attend the occupant of the Korean throne have led to the establishment of cities of refuge within easy reach of the capital, in which provisions are stored against an evil day. Seoul has two of these retreats, the one within a few miles of the Palace, to which rumour has it there is an underground passage; the other some 25 miles off. In their selection, and in the choice between them when danger threatens, the Shamans have also been consulted. Oddly enough these refuges are defended by soldier priests of the Buddhist Church.

Among the monumental remains in Korea, there are some few dolmens. These are interesting, apart from other causes, through the fact that though dolmens are common in Japan, they are not found in China, and that Korean dolmens resemble in structure those found in West India, while the Japanese have closely allied forms in West Europe, but have nothing resembling them in Asia until we reach the shores of the Caspian.

Mr W. Gowland, to whose papers read before the Anthropological Society, I am indebted for these and other particulars, made a special study of dolmens in Japan, and paid a visit to Korea, partly with the object of examining the dolmens of that country. I had a short time previously come across one near the high road from Chemulpo to Wonsan, consisting of a rough flat stone, about seven feet square, resting on two small upright stones placed at its north and south ends.

Near this Mr Gowland found another, of which he gives full particulars. Its site is on "an irregularly shaped grassy plot, about one foot to eighteen inches higher than the adjoining field, but there are no existing traces of a mound, and probably from its construction it was never

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covered by one, but was intended to stand as a monument above ground." And in this respect it differs from Japanese dolmens, which, without exception, are all buried in tumuli. The stones composing it are of granite, and had been brought from the neighbouring hills. At first sight it seemed to consist of hewn stones, but a closer examination showed that their flat sides and slab-like form were not due to artificial fashioning, but to the geological structure of the granite of the district.

"The chief megolithic feature of the dolmen is its capstone, the dimensions of which are: length, 14 feet 6 inches; breadth, 13 feet 2 inches. In thickness it varies from about 9 inches to 18 inches, the average being rather more than one foot. Each of its four sides is formed of a single stone set up perpendicularly. Three of these stones are unbroken.

"The chamber is small, measuring but 6 feet in length, 4 feet 1 inch in breadth at the north-east end, and 3 feet 9 inches at the south-west end. Its present height is 2 feet 9 inches from the floor to the lower side of the capstone, and its open end faces the south-west. The stones forming the sides are only from 8 inches to 9 inches in thickness, and the end stone is only about 6 inches. No remains were found in the chamber, not even fragments of pottery. One of the chief peculiarities of this dolmen is the disproportionate size of the capstone compared with the side stones and the size of the chamber. In most dolmens, wherever found, one of the most marked features is generally the large size of the capstone, or capstones, if there are more than one; but I know of no other example in which it so greatly exceeds the size of the chamber and supporting stones as this. One is mentioned by Fergusson in Western India, in which the capstone measures 15 feet 9 inches by 8 feet 6 inches, and the chamber 8 feet by 6 feet, but the upright stones are there more than

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1 foot in thickness. In other respects dolmens of a somewhat similar form have thus far only been found in Asia in two places far distant from Korea—in West India and in Syria.

"The dolmen of Korea may be considered as intermediate in form between a cist and a dolmen. In the size of its chamber it resembles a cist, whilst its large capstone gives to it the characteristic feature of a megolithic dolmen. * * These dolmens are entirely distinct from those of Japan. There are no free-standing dolmens in that country: all are more or less completely covered by mounds. Japanese dolmens, too, either possess a distinct chamber, which is approached by a gallery of greater or less length, and narrower than the chamber itself, or more rarely they are of the form known as 'Allée couverte,' in which the space enclosed by the side stones resembles a long gallery of considerable dimensions."

Mr Gowland hence comes to the conclusion that Korean dolmens were built by an early tribe, ancestors of the present Koreans, and subsequent to the migration of the Japanese.

He adds that it is important to record that these rude sepulchral monuments are not surrounded by circles of standing stones, which indeed never occur either in Korea or Japan.

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# THE RUDE STONE MONUMENTS OF INDIA

BY

W. CROOKE, B.A., F.A.I.

(Plates IV. & V.)

(Read February 14th, 1905.)

India is the land of survivals in custom and culture. "Everywhere," as Fergusson writes, "the past is the present, and the present is the past." Among all its varied races the ultimate test of the value of any observance is whether it conforms to primitive custom, or does not conform to it.

In no department of ritual does this feeling of conservatism so strongly rule as in the cult of the dead, and in the method of disposing of the corpse. The reason of this is obvious. If it be not the case, as some have imagined, that most of the gods of India are deified men who once lived upon earth, the connexion between the death *cultus* and the beliefs of Hinduism is very close. We can thus see at the present day usages of the most archaic variety practised side by side with those of a more modern type. The system of caste, which enforces the isolation of the people into distinct endogamous groups, naturally tends to perpetuate practices of this kind. We find some castes or races which cremate the dead and bury the bones: others cremate and fling the ashes into a running stream. Some bury in rudely-excavated tree-trunks: others in a grave so arranged as to prevent the earth from touching the corpse:

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others, again, in a shelf cut in the side of the grave. Some merely deposit their dead in the jungle to be devoured by wild beasts: some bury the remains naked: some use a shroud. Some erect platforms on which the body is allowed to decay: others disinter the bones after corruption has done its work, and remove them to a tribal or family ossuary.[1]

India, then, with its survivals of archaic death customs, and its varied methods of disposing of the remains, presents a particularly interesting field for enquiry. While death customs, as they exist at present, have been pretty thoroughly explored, little has been done as yet to collect and bring into order the information which it so lavishly furnishes on the subject of Rude Stone Monuments. Fergusson was probably right when he asserted that such remains were more numerous in India than in any other part of the world. But, up to the present time, the facts connected with this important subject have lain scattered through a vast literature, consisting of official reports, isolated memoirs, and the publications of learned societies. It is only quite recently that a most valuable contribution to the investigation of this subject as a whole has been made by my friend, Mr V. A. Smith, who has prepared an admirable summary of the information we possess on prehistoric India which (with a very useful bibliography) will appear in the forthcoming edition of the "Imperial Gazetteer." Mr Smith, for the preparation of this paper, kindly placed all his original notes at my disposal, and, needless to say, I am much indebted to them.

The archæologists of Europe have mapped out the history of pre-historic man in that part of the world into four great periods: the Palæolithic, of rude stone implements; the Neolithic, of polished stone-implements: the

1 *Vide* W. Crooke, "Primitive Rites of Disposal of the Dead, with special reference to India"—Journal Anthropological Institute, xxix. (1889), p. 271 *et. seq.*

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Bronze; and the Iron Age. The same evolutionary sequences of cultures prevail in India, with this exception, that the Neolithic Age was followed by an Age of Copper; and no distinctly marked Bronze Age preceded that in which the use of iron was discovered.

Stone-implements are found more or less extensively over the whole Peninsula, from the south districts of Madras along the western coast to the Indus valley; all through the central plateau of the Deccan with its surrounding ring of hills; and far to the east in Burma. They are found isolated at considerable depths in the Alluvium, and have been disinterred from beneath the sites of the oldest human settlements in the country. In some places, as in the Mirzapur District, what seems to have been an ancient implement-factory has been discovered.

Here, as in other parts of the world, the ages of rough and polished stone overlap. As is the case in Europe, all implements of the neolithic period are not necessarily polished, and it is practically impossible to decide to which period many of the examples belong. The case is still further complicated by the fact that up to quite modern times some of the tribes occupying the central tract were in the Age of Stone; others, as is shown by the shape of their iron-implements, have only quite recently emerged from it. But at the present time the use of stone-implements is confined to a few tribes on the very frontier of the Empire, those bordering Assam and Burma on the north-east; and the degraded Andamanese chip bottles left by sailors into razors and lancets to the present day.

While recent discoveries in France establish in the opinion of some authorities[1] a continuity between the Palæolithic and Neolithic Ages, the case is different in

1 Windle, "Remains of the Prehistoric Age in England," p. 11: disputed by Prof Boyd Dawkins, "Journal Anthropological Institute," xxiii, 242.

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India. Here, to quote Mr Bruce Foote,[1] one of our best archæologists in India, "the geological evidence afforded by the formations in which the chipped stone-implements of palæolithic type are found indicates—especially in the sections in western India—that a great gap, historically speaking, exists between the date of deposition of such formations and of the beds in which, or on which, the earliest traces of neolithic man are met with. The geological evidence in Southern India, though less strikingly clear, points in the same direction."

How far this distinction rests on a difference of race we are unable to say. We have, so far as is known at present, no record of a palæolithic interment in India, and the evidence to be gained from a comparison of skull forms is therefore wanting. But as attention is now concentrated on the subject, it may be hoped that materials for settling the question will be obtained.

It must, however, be said that while in Europe attempts have been made to identify objects of human handiwork in the rocks of the Miocene period, the Indian geologists seem to agree that the palæoliths are found in the Pliocene series.[2] If this be so, the existence of early man in India lasted through a considerably shorter period of time than some authorities have claimed for him in Europe. The probability seems to be that the palæolithic race in India, separated by a wide gap from the neolithic, was different in origin. How far any remains of it may be recognised in the present population it is impossible, in the existing state of our knowledge, to determine.

On the other hand, the geological evidence discloses the existence of no gap in time between the neolithic people and their successors, who gradually acquired a knowledge of the use of metals. And, though the overlap of the two stages of culture has not, so far as we know at present,

1 "Catalogue Madras Museum," Intro., p. iv.
2 Windle, *Op. cit.*, p. 2; Bruce Foote, *Op. cit.*, Intro., p. viii.

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been traced in relics from interments, it has been established by the study of primitive dwelling sites throughout the Deccan.

As I have already said, the existence of a well-defined Bronze Age has not been established in India. As in most other places, a Copper Age seems here to have preceded that of Bronze, the knowledge of a suitable alloy for the softer metal being only gradually acquired. When no suitable metal was available, as in India, the Copper Age was naturally longer and better-marked. In Europe, on the contrary, the facility with which tin was procured in England and antimony in Hungary led to the earlier disestablishment of copper by bronze. Only one undoubted bronze tool has as yet been identified in India, but in South Indian graves some elegant vases of that metal, which specialists are inclined to believe to have been objects of luxury, imported possibly from Babylonia, have been discovered.

On the other hand, the Copper series is large and important. The ore is found largely throughout the Peninsula, and the traces of early workings of this metal, particularly in Nellore to the south and in Singhbhum and Hazaribagh in the east-central hills prove that its extraction was an important industry in early times. This is corroborated by the fact of the persistence to modern times of the custom which appropriated this metal to the various articles connected with the worship of the gods. Large hoards of arms and remarkable chisel-shaped copper implements, of which the British Museum possesses specimens, have been found in various places.[1]

Gradually the Copper Age was replaced by the Age of Iron—the ore being found extensively all through the southern portion of the Peninsula, where it is still worked in a crude way by the Agariyas and other jungle races,

1 Read, "Guide to the Antiquities of the Bronze Age in the B. M." 67 f.



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their present methods probably reproducing those of the period when the metal first came into use.

For the examination of the Indian Rude Stone Monuments, it would be of great interest to consider the information which would enable us to fix approximate dates for the sequence of these periods of early man in India. But at present no such evidence is forthcoming. Prof. Ridgeway fixes the period in Europe of transition from bronze to iron at from 850 to 600 B.C. Whether this change occurred earlier or later in India we have at present no means of determining. There are constant references in the Rigveda to a metal called *ayas*, which in some places seems to be merely a generic name for "metal." In the Atharva-veda it is referred to as "dark" and "red," which, as Prof. Macdonell remarks, "seems to indicate that the distinction between iron and copper or bronze had only recently been drawn." He goes on to say that: "It is, moreover, well known that in the progress of civilization the use of bronze always precedes that of iron. Yet it would be rash to assert that iron was altogether unknown even to the earlier Vedic age."[1]

With the Iron Age we come to the era of the Rude Stone Monuments. No relics discovered in connexion with interments associated with them warrant us in tracing them to an earlier period.

It may be well first to define the terms in use. The earliest form is probably the mound or tumulus, which when constructed of stone we usually call a cairn. But some confusion has been caused by Mr Breeks, one of the best of our working archæologists, extending the term "cairn" to "a circular enclosure formed either by a rough stone wall, or heap, or by single stones."[2] This is a form

1 Macdonell, "History of Sanskrit Literature," p. 151. The question is discussed at length by Schrader, "Prehistoric Antiquities of the Aryan Peoples," E. T. F. B. Jevons, pp. 157 ff.

2 "Primitive Tribes of the Nilagiris," p. 72.

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of monument which most European archæologists would call "a circle."

Next come the two structures known as a dolmen and a kistvaen. The dolmen is originally a cell, such as those found in the long barrows of Europe, which may or may not be covered with a mound. The theory of Fergusson that they were always sub-aerial is not now generally accepted.[1] The kistvaen is a smaller variety of the dolmen, but it usually differed from it in the fact that, unlike the dolmen, it was usually not intended to be reopened for secondary interments. It was generally covered with earth, but, like the dolmen, it often in course of time has lost this protection. Mr Breeks again extends the title of kistvaen to "a vault of large stone slabs, closed on every side, but sometimes with a round hole in one of the walls, with or without a surrounding stone circle or tumulus";[2] while he calls the structure open on one side a "cromlech." We should rather call both these structures "open" and "closed" dolmens. The circle and the menhir, or standing stone, will be discussed separately.

To begin with the tumulus or mound. The tumuli of India, when built solely of earth, naturally tend to disappear under the disintegrating influence of the climate, and those of early date are now not easily identifiable. The stone cairn is, of course, less perishable in its nature. Most of these erections are probably sepulchral, but Mr Walhouse regards some of those in South India as rather memorial or commemorative.[3]

Numerous examples of the tumulus, ancient and modern, have been discovered in various parts of the country. Those constructed over the graves of the old Kings of Assam are described by Gen. Dalton[4] as very

1 Windle, *Op. cit.*, p. 174 f.
2 *Op. cit.*, p. 72.
3 "Journal Anthropological Institute," vii., 22.
4 "Descriptive Ethnology of Bengal," p. 9.



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extensive. When opened, the remains of the dead have been found enclosed in coffins of massive timber, with gold and silver ornaments, and outside the coffin were placed various utensils, arms, and implements of agriculture, all doubtless intended for the use of the royal ghost in the world beyond the grave. In the same part of the country the Khamtis still build conical tumuli to cover their dead. These erections diminish from the base to the apex in a series of steps, the earth around each step being kept in position by bamboo matting.[1] The same is the rule with other tribes of Bengal who are of the Dravidian or pre-Aryan family. Thus, among the Parghas and Binjhias this mode of burial is used in the case of those who perish by a violent death, and sometimes in addition to the piling of the tumulus, the precaution is taken of placing a bundle of thorns in the mouth of the grave.[2]

We thus reach the primitive conception of the tumulus —that its weight was intended to prevent the ghost from "walking."

The stone cairn we constantly see among the forest tribes of the Central Hills. Here it is, as a rule, commemorative, or rather, if we explore deeper the psychology of the people who erect them, it is intended to provide an abiding place for the soul or ghost of the dead man, an edifice which he may permanently occupy, and there receive due sacrifice and honour from his descendants. Thus, it is very generally erected on the spot where a person has been slain by a tiger, and here the tribal priest periodically sacrifices a fowl and lights a lamp to appease the ghost. The idea is that the ghost of a person meeting his death in this way must naturally feel irritated at being so unceremoniously hustled out of this world, and is thus likely to be sulky and vicious in nature.

1 *Ibid*, p. 10.
2 Risley, "Tribes and Castes of Bengal," i. 136, ii. 164.

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In some of the older examples of the Indian tumuli, an additional protection is afforded by the erection of a circle of standing stones round the mound, the special significance of which will appear later on.

But in studying the embryology of monuments of this kind it is important to note the later evolution of the tumulus. At the outset it is merely an earthen grave-heap: with stones added it becomes a cairn. The cairn, finally, when cased with carved stones and provided with other architectural ornament, turns into the Stupa or Tope, which was introduced by the Buddhists to provide for their worship of relics, primarily those of the Master himself. But as time advanced, all these buildings did not contain the relics which have occasionally been found in a stone chamber, the successor of the kistvaen, buried deep down in the body of the mound. Many of them then became merely dedicatory or memorial. Some of these Stupas were magnificent structures, and the type survives in the comparatively modern Shwè Dagon, or Golden Shrine, which dominates the city of Rangoon, and is regarded with the deepest reverence by the Buddhists of Burma.[1]

We next come to the dolmen and the kistvaen. As I have said, monuments of this class are found in great numbers in India; but we have not as yet sufficient information to construct a map showing their exact distribution. They do not appear north of the Vindhyan range of hills, which is a sort of backbone of the Peninsula, running from about the latitude of Bombay to that of Calcutta, and dividing Hindustan, the seat of the original Aryan settlements, from the Deccan or Southern plateau. They are very common in the country drained by the two great southern rivers, the Godavari and the Krishna, or

1 For Stupas, see Fergusson, "History of Indian and Eastern Architecture," chap. iii.

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Kistna; and all along the Eastern and Western Ghats, the hills which flank on both sides the Central plateau, right down to Cape Comorin, the most southerly point of the Peninsula.

The most natural inference to be drawn from the facts of the distribution of these monuments, so far as our present knowledge goes, is that not being found in the distinctively Aryan country, they can have no connexion with that people. Whether they were the work of the tribes now represented by the Dravidians of South India, we are not in a position to decide with confidence. But such evidence as we possess points to the conclusion that this was the case.

The first problem in dealing with this class of monuments is to consider what may be their age. Fergusson, you may remember, used all his great scientific knowledge and acumen in endeavouring to bring down their construction within quite historical times. Whether we accept or do not accept the conclusions at which he arrived, no one who has worked at this branch of archæology can refrain from expressing admiration for his excellent book. His argument mainly rested on the fact that within the northern or Aryan country building in stone did not begin till about the middle of the 3rd century B.C.: and that therefore the Rude Stone Monuments could not be fixed at a date earlier than this. Most of them, he thought, must be five, or perhaps ten centuries after that date.[1]

The assertion that the earliest stone buildings in North India date from about the time of the Buddhist Emperor Asoka *(circa* 250 B.C.) may be accepted as well established. Up to that time the material used by the Aryan builders was probably wood. For this an obvious reason may be assigned. The Aryan land in the valleys of the Indus, Ganges, and their tributaries is a vast alluvial plain.

1 "Rude Stone Monuments," p. 493.

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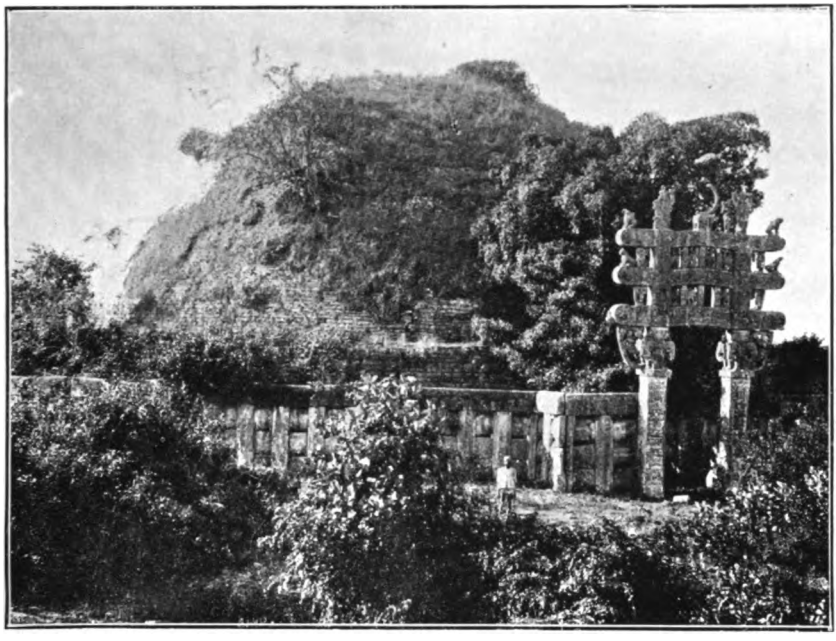

Fig. 1.—BUDDHIST STÛPA, WITH RAIL AND GATEWAY, AT SÂNCHI, BHOPÂL STATE, CENTRAL INDIA.

Fig. 2.—SCULPTURE ON DOLMEN, AT MELLÛR, NILGIRI HILLS, SOUTH INDIA.

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Nothing in the way of building stone is obtainable there, except the substance known as Kankar, a coarse, nodular, calcareous limestone, which cannot be quarried in large blocks, and is suitable only for the very rudest masonry. It is true that in the hills which overhang this alluvial tract, there are splendid quarries of white or red sandstone, which in later times supplied the materials for the magnificent Moghul palaces at Agra, Delhi, and Fatehpur-Sikri; while from Rajputana came the fine marbles used in the celebrated Taj Mahal and other highly ornamented buildings. But in early times these quarries were doubtless inaccessible, and the art of brick-making, if known, was not largely prosecuted.

In the hilly districts further south, on the other hand, the supply of stone in detached boulders was inexhaustible, and it is hence easy to understand how the Dravidians of the South, or whoever were the original builders of these monuments, used the material which lay ready for use long before the Aryans of the North came to erect buildings in stone.

In the case of the stone circles, Fergusson manfully faced a special difficulty of another kind. One of the most distinctive types of Buddhist art is found in the elaborately sculptured rails with which they surrounded their Stupas or reliquary mounds. Such is the rail surrounding the Stupa at Sanchi (Plate IV. fig. 1), which Fergusson thinks may be dated about the first century of our era. To maintain his theory of the late origin of stone monuments generally, he was forced to adopt the position that the rude stone circle was derived from the elaborately carved Buddhist rail, and was therefore of a later date. To most authorities since his time it has appeared simpler and more in accordance with the usual law of evolution to suppose that the Buddhist rail was gradually developed from the rude stone circle of the tumulus.

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Later enquiries, I need hardly remind you, have not supported Fergusson's views. The excavations conducted by Professor Gowland at Stonehenge show that the worked trilithons were made in neolithic times, and a date as high as seventeen centuries before our era has been assigned to them.[1] The safest conclusion seems to be that Stonehenge dates from about 2000 to 1800 B.C.

Now it is quite impossible to attribute to all the monuments in rude stone of Southern India anything like such a high antiquity as this. Here the special difficulty is that while in Europe, for instance in England, the series of these monuments was definitely closed about the time of the Roman occupation, their construction in India has been continuous to the present time. In other words, in India there has been no break between the archaic and the modern culture. "Had it not been first the Roman, and then the Celt, by sword and cord set vigorously to improve the older races," writes Fergusson, "we might now have human sacrifices celebrated on the plains of Beauce, in the neighbourhood of Chartres, and find people quietly erecting dolmens in the valley of Dordogne."[2]

In India it was very different. The Aryans seem to have made no effort to occupy the Deccan plateau, though they may have sent missionaries to convert the tribes. Even in later times, when the Mohammedans overthrew the native dynasties, their control over South India remained imperfect. The kingdoms which they established in the Deccan were dependent on the goodwill of their Hindu subjects, and the rulers never interfered with the traditional rites and customs of their people. With the wild tribes of Assam the Mohammedans never cared to interfere, and it was not till our own day that they were reduced to order.

1 "Man," 1902, pp. 6-10; Windle, *Op. cit.*, 185 ff.
2 *Op. cit.*, p. 460.

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The problem of Stone Monuments in India is therefore quite different from that which concerns the archæologists of Europe. To the west we have a date which we can approximately fix, after which we are certain that no monuments of the kind were constructed. In India monuments of this class are being made under our very eyes. We have always to speculate whether a particular example is old or new. This, of course, is particularly difficult when we have no architectural style to guide us, and where the evidence of decoration is hard to interpret.

Hence we may safely infer that the monuments of South India are of very differing ages. Some, for instance, contain punch-marked coins, which cannot be earlier than 600 B.C., and may be many centuries later. In most of them, again, iron implements are found associated with wheel-made pottery, ornaments of copper, bronze, gold, and silver, many of which were possibly imported from Babylonia. The possibility that in some instances this admixture may result from secondary interments must not be overlooked. At the same time, the age of some examples must be very great. The Iron Age pottery and implements, of which illustrations will be found in Mr Bruce Foote's catalogue, and in the records of excavations by Mr Breeks, represent a very archaic period of art and industry. The latter writer[1] points out some resemblances and differences between the "finds" in India and Europe. In Europe we find with the interments cinerary urns, food-vessels, drinking cups, and the so-called "Incense-cups," found inside the cinerary urns, placed on or among the calcined bones, and frequently themselves also filled with burnt bones. Vessels of the last kind in India are seldom of clay, almost always of bronze, and here the food-vessels are replaced by figured pots. It is

1 *Op. cit.*, 95.

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also remarkable that both in India and Europe these vessels are often found inverted. In England it is often the cinerary urn which is inverted: in India this is the rule with the bronze vessel, which is not always found over or with the calcined bones, but often in quite another part of the circle. Mr Breeks, a very sober enquirer, fixes for the Nilagiris circles the lowest possible date of construction at four or five centuries ago, because the Badaga tribe, who entered the country some three centuries ago, know nothing of them. How much older they may be he declines to speculate, but he points out the continuity of custom in the present funeral rites of the Todas, which are performed to this very day in stone circles.[1]

It would be most important in considering the age of these monuments if we were able to arrange them in anything approaching a chronological sequence. In the Nilagiris Mr Breeks finds no apparent connexion between the circles and the dolmens—the former occupying the high, bare ridges of the plateau; the latter situated on the lower slopes. In his opinion the dolmens are not generally sepulchral, and the few objects found in them differ from those occurring in the circles, and are probably more modern.[2] Mr Logan,[3] who devoted much attention to the monuments in Malabar, divides them into five classes—megalithic remains and excavated caves, probably synchronous; caves with massive urns, and massive sepulchral urns not found in caves, and, lastly, modern sepulchral urns of small size. These last probably come latest in order of time, but the relative ages of the older monuments cannot, it would appear, be fixed with certainty.

Another line of evidence by which the antiquity of these remains may be estimated is supplied by the attitude of the tribes which now occupy that part of the country

1 *Ibid.*, p. 96.
2 *Ibid.*, p. 100.
3 "Malabar Manual," i., 179 ff.

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towards them. Thus, to take that remarkable race, the Todas, Col. Marshall writes[1]: "Not only the summit of the Nilagiris, but the tops of the minor rounded eminences thereon are studded with cairns, raised for the reception of the ashes of the dead, by a race whose history has been so completely lost that not a tradition of it even remains. It is true," he adds, "from relics exhumed from cairns, that their owners made use of the horse: that they practised agriculture, holding the buffalo in high esteem, and burying its bell with the manes of the deceased;" and "in the custom of cremation, the regard shown to buffaloes, the especial notice of its bell, the practice of burying weapons and personal ornaments," he finds almost an identity with the obsequies and modes of thought displayed by the Todas.[2] On the other hand, to quote Mr Breeks,[3]—"Against the theory that the cairns [circles] belong to the Todas, it has been urged that they do not claim them. This is not strictly correct; they do, as has been shown, claim some. But even if the statement were entirely true, it is not of much consequence with a people like the Todas. I have known a Toda, while pointing out the Azarams [circles] in which a funeral ceremony then going forward was to terminate, profess entire ignorance of the object of some other stone circles close at hand, obviously old Azarams belonging to the same mand [settlement]: so that their disclaimer of the cairns carries little weight." Mr Walhouse adds that the Todas regard the old circles as tabu and will not touch them.[4]

Little light is thus gained by this investigation; but so much is fairly clear. The modern Todas use stone circles and conform in their death rites to those people who built the earlier monuments, to which they pay a certain amount

1 "A Phrenologist among the Todas," p. 8.
2 *Ibid*, p. 9.
3 *Op. cit.*, p. 99.
4 "Journal Anthropological Institute," vii. (1877), p. 29.

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of respect; and here, as everywhere in India and elsewhere, the peasant's memory of the past and his beliefs about the monuments he sees about him are of little value. On the whole, it would seem probable that the modern Todas are the descendants of the ancient builders: but how many generations have elapsed no one can say with any approach to certainty.

"The Badagas, again," Mr Walhouse goes on to say, "who are the most numerous and recent of the hill tribes, have turned the dolmens into sacred places, not looking on them as temples, but as actual gods. When it was proposed to remove some of the sculptured slabs to a Museum, they remonstrated, saying, 'They are our God.'" The Kurumbas, another very wild tribe, come up annually to worship a dolmen in the higher hills, in which, they say, one of their gods resides. When a member of the tribe dies, the relations place a water-worn pebble in a dolmen, apparently to serve as an abiding-place for the ghost. All this is just what we might expect to find among a people many of whose gods are deified mortals—the tomb being naturally regarded as the house of the sainted dead of the ancient race.

One fact at least points to the conclusion that some of these remains are very ancient. Folk-lore has been at work, and has treated them in its usual fashion. As the ancient tumulus in Europe has become a fairy meeting-place, the fairies having disestablished the ghost of the original occupant, so in South India numbers of stupid legends have been invented to explain the monuments, or to bring them within the cults of the more modern races.

All we can say, then, is that some of these monuments go back to the early Age of Iron, that some belong to the historic present: that others, it is not improbable, may have been used in succession by different races occupying the country.

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Here comes in the question of the sculptures found on some of the slabs. These undoubtedly show an advance on the old rude stonework. The date of these carvings has not, I think, been ascertained with precision. Mr Walhouse is disposed to connect some of them with the Basava, or Lingayat sect, who worship the phallic emblem of Siva, the founder of which was born early in the twelfth century of our era. He thinks that fugitives of this sect, driven by persecution from the plain country, may have annexed the monuments and executed the carvings. We often find crosses carved on European dolmens with the object of christianizing the old pagan cult,[1] and there is no improbability in the theory that the Lingayats may have done likewise.

Leaving the most interesting modern rude stone monuments—those of the Khasis—to be described later on, we have numerous examples of modern dolmen and cairns. Mr Breeks describes the Kurumbas of Madras as still burying their dead and using old dolmens for the purpose, while a later authority states that they still erect a dolmen on a small scale when one of their headmen dies.[2] Mr Walhouse describes temples in Mysore, consisting of back and side slabs laid on edge, with a covering slab over, containing an image of Hanuman, the monkey god, with flowers laid before it. "Of course," he remarks,[3] "these rustic shrines are not prehistoric, but then use and tradition may have come down from prehistoric times."

Burial in the manner of the old kistvaen or cairn is common among the wilder tribes of the present day. The Murmis of Nepal, who preserve the Buddhist tradition, bury their dead, and raise a small enclosure roofed in with a big stone round the grave, over which a cairn is piled.[4]

1 Borlase, "Dolmens of Ireland," ii., 650, 666.
2 Breeks, *Op. cit.*, p. 54 f.; "Journal Royal Asiatic Society," 1887, p. 693.
3 *Op. cit.*, p. 26.
4 Risley, *Op. cit.*, ii., 112.

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The Hanbars, a primitive tribe of the Deccan, bury the dead and lay a heavy stone on the grave.[1] The Gonds of the Central Provinces have a curious modification of the tumulus, circle, and menhir. They raise a square mound over the remains, plant wooden posts at each corner, round which they tie a thread encircling the mound, and finally set up a stone in the centre.[2]

The question of burial in dolmen and kistvaen may be considered together. It has been suspected that it marks a higher stage than tumulus burial, where the primary object probably was to weigh down the ghost and prevent it from "walking." Now, in the kistvaen and dolmen we have the analogue to the primitive underground house, and the chambered barrow has been aptly compared with the form of dwelling now in use among the Lapps and similar tribes.[3] The primary object here is to provide for the comfort of the ghost, and this is combined with the idea of repressing its malignity by the weight of the cap-stone which covers it.

Another reason for the custom of house burial was the hope that the soul of the deceased might be reincarnated in the family; and for this reason in the Punjab children are buried under the threshold, in order that as the women of the family step across it, they may conceive the spirit of the lost one. Many of the wilder tribes in India erect a shed or hut near the grave for the repose of the ghost. Thus, the Devangas, weavers in North Arcot, build a small hut made of milk-bush branches over the grave.[4] The Khyens erect a hut near the tomb, in which the friends sit to scare away any evil spirit which might molest *their* ghost.[5] The Garos build the funeral pyre close to the family house, obviously with the hope that the ghost

1 "Bombay Gazetteer," xxiii., 109.
2 Hislop, "Papers relating to the Aboriginal Tribes of the Central Provinces," p. 19.
3 A. J. Evans, "Archæological Review," ii. 314 f.
4 Cox-Stuart, "Manual of North Arcot," i. 227.
5 Dalton, *Op. cit.*, p. 115.

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may take refuge there.[1] The Gonds of the Central Provinces used to bury their dead in the house, but now prefer to use a burial ground near the village.[2]

In the same class comes probably the custom of burying in caves, the home of the early troglodytes. Many such interments have been found along the Vindhyan hills dating as far back as neolithic times, a fact proved by the occurrence of agate knives with the remains. In fact, as Mr Windle observes,[3] the chambered tumulus is an artificial cave, composed of masses of stones arranged to form a cell.

The same idea appears in what is known as shelf-burial, of which I have elsewhere[4] given many examples. Here the side of the grave is hollowed out, and the corpse is deposited in a niche at one side.

We now come to the actual structure of the Indian dolmens and kistvaens. From the pictures which were thrown on the screen,[5] and which all represented monuments from Southern India, it was seen that in form and general structure the Indian examples were analogous to those found in Europe. Not that this implies, as has sometimes been rashly supposed, that the dolmen builders came from East to West, or *vice versâ*, or that the nations who buried their dead in this way were necessarily sprung from a common stock. It rather points to the fact which we find illustrated in the case of stone implements, that people using any material for the same definite purpose, are apt to work it up in the same way.

The classification which Fergusson adopted from Col. Meadows Taylor divides the Indian dolmens into two

1 *Ibid.*, p. 67.
2 "Central Provinces Gazetteer," p. 278.
3 *Op. cit.*, p. 132.
4 "Journal Anthropological Institute," xxix. 280 f.
5 Some of these photographs are reproduced in Mr Breeks' book. For other illustrations of Indian Rude Stone Monuments, see Borlase, "Dolmens of Ireland," iii. 750 ff; Fergusson, "Rude Stone Monuments," 455 ff.

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classes—the "closed" and the "open." In the former the chamber consists of four stones forming the sides, and the front or door-stone always has an opening in it. In the second class there is no door-stone, and the dolmen presents the character of an open box covered with a stone flag. It is admitted on all sides that the "closed" dolmen was intended for inhumation. The "open" dolmen presents a more difficult problem. In one case, quoted by Mr Walhouse,[1] the "closed" and "open" dolmens appeared mixed up together, and here they could never, he thinks, have been covered, as they rest upon the bare rock.

Now in describing the stone monuments of the Khasi tribe on the Assam frontier, Major Godwin-Austen figures one of these "open" dolmens as an ossuary or bone-repository. The Khasis, he tells us,[2] remove the bones after cremation to a structure of this class, which assumes various forms, but is always covered with a heavy stone slab. In the example of which he gives a drawing he thinks that the closing slab in front has fallen on the family becoming extinct. Mr C. B. Clarke,[3] writing of the same people and describing these "ashes-cists," says: "So long as they contain earthen jars they cannot be mistaken: but by the continual collection of family jars the majority of the square cists are left with one side broken down and empty, and in such a state it is sometimes impossible to determine whether the horizontal slab be a monument or the lid of an old cist, unless a family can be found to claim it as their monument. Where there are no upright monumental stones near, I incline to suppose that a large majority of these doubtful remains are cists and not monuments."

On the analogy, then, of these Khasi ossuaries, we may find an explanation of the object of some at least of these

1 "Indian Antiquary," vii. (1877), p. 30.
2 "Journal Anthropological Institute," i. 140; i., 131 f., and see v. 37 ff.
3 *Ibid.*, iii., 485.

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puzzling "open" dolmens in Madras. The custom of erecting family or tribal ossuaries is not uncommon. For instance, among the modern tribes we find that the Nagas of the Eastern frontier erect little huts close to their villages in which they preserve the bones of their dead; the Mundas of Chota-Nagpur bury the bones after cremation, and place a stone slab over the hole, not resting on the ground, but on smaller stones, which raise it a little. These stones may cover the graves of several members of a family: but the ghost of a Ho, an allied tribe who practise the same rites, likes to have a grave all to himself.[1] In the same way the Bhils of the West Central Hills have tribal or family cemeteries filled with small vessels containing ashes and bones. From this it is not a difficult step to the very remarkable structures found near Calicut by Mr Logan,[2] which contained underground chambers, couches, and a fireplace. It was apparently intended to serve as an ossuary, and, like the Egyptian tombs, was provided with all that was considered necessary for the comfort of the spirits of the dead.

At the same time it is deserving of notice that while the circles and kistvaens almost invariably contain ashes, bones, and other funereal relics, the open dolmens contain nothing of the kind. Fergusson, who held the opinion strongly that these "open" dolmens were sepulchral, inclined to the idea that they had been rifled. If the dolmen was occasionally or permanently left open by accident or design, it is quite possible that the bones may have been removed by animals, and this is perhaps more possible on the supposition that it was merely a place in which bone-jars were stowed away. At the same time it is difficult to understand how all relics of the dead could completely disappear. Hence Mr Breeks[3] denies that they

1 Dalton, *Op. cit.*, pp. 40, 203.
2 "Indian Antiquary," vi., 309.
3 *Op. cit.*, 105.



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are sepulchral. He regards them as merely memorials of the dead, and he points to the custom of the Kurumbas of Madras and the Kols of Chota-Nagpur putting perishable offerings in such places. It may be difficult to draw a clear line of distinction between a tomb, an ossuary, and a memorial. All we can say at present is that the "open" dolmens were apparently used for one or other or all these purposes.

What are called "holed" dolmens (Plate V., fig. 2) are found in large numbers in the Deccan and Southern India. Many explanations of the meaning of these holes in the door-stone have been given—that they are intended as a means of exit for the ghost when it feels disposed to leave its home; that they are a means of passing in offerings of food or other articles for the comfort of the ghost; that they illustrate the habit of creeping through an orifice or narrow entrance to a cave or structure of the kind, which is supposed to be efficacious for the cure of disease.[1] Mr Walhouse[2] describes some of these holes as only large enough to admit an arm: others which would allow of a child being passed into the inner chamber. Ancestor worship prevails widely in India, and the place occupied by the sainted dead would naturally be held sacred, and food would be supplied for the nourishment of the ghost. It is quite reasonable to suppose that the kindly ghost may be able to cure an injured limb, or restore an ailing child to health, and the "holed" dolmen may have served one or other or both these objects.

From the dolmen and kistvaen we pass to the circle. We have already seen the improbability of Fergusson's theory which would derive it from the Buddhist rail. In its more primitive form the circle is the line of stones surrounding a tumulus, intended to support the base of the

1 Borlase, *Op. cit.*, ii. 626 ff; Crooke, "Popular Religion and Folk-lore of N. India," ii., 165 ff.

2 "Indian Antiquary," iii. 277.

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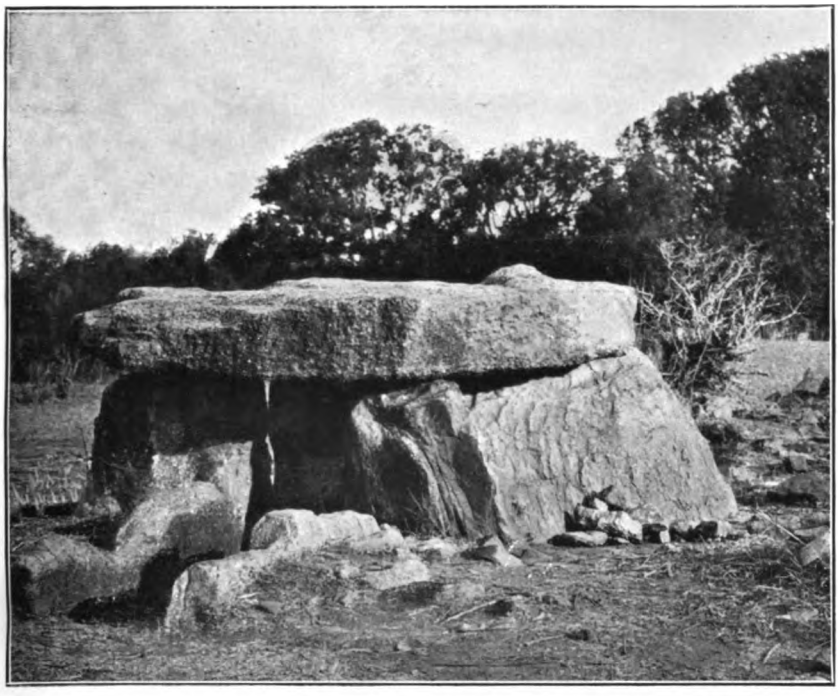

Fig. 1.—DOLMEN AT GOKÂK, BELGAUM DISTRICT, BOMBAY PRESIDENCY.

Fig. 2.—HOLED DOLMEN AND KISTVAENS, NILGIRI HILLS, SOUTH INDIA.

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mound, or to indicate that it was a place under tabu, or to act as a "ghost-hedge," to enclose and restrain the angry ghosts of the dead. Those who look at primitive constructions of this kind from the point of view of the psychology of modern savages will be inclined to believe that superstitious motives are usually antecedent to merely practical considerations, and that the original idea of the stone circle was probably either to prevent intrusion on a sacrosanct place, or to bar in the ghost occupying the site; or rather, perhaps, both considerations may have combined to establish the practice.

Again, we can trace the gradual evolution by which the circle becomes detached from the tumulus until it occupies the position of an independent monument. But probably in most cases it preserves the original idea in its construction when it was erected to secure a place of interment.

Further, the circle is very closely connected with the avenue such as we see at Carnac. Gigantic erections of this kind are not found in India. But we see the embryo from which they grew in the long stone passage of the underground tomb, like that in the long barrow at Uley, in this county. The gateway of this passage, again, develops into the trilithic monuments of the Khasis of Assam, which we see in its highest form in the outer circle of Stonehenge.

In the case of the Indian circles, the same difficulty presents itself as in the case of the dolmens—the continuity of construction of such monuments from the earliest to the most recent times. Thus writing of the Todas, Mr Breeks[1] says:—"I could not ascertain with any certainty whether these stone circles which are always to be found near the funeral mand [hut] had been constructed in recent years, or were of considerable antiquity. Their appearance, however, did not suggest any great age.

1 *Op. cit.*, p. 24.



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From the Todas whom I questioned on the subject it was very difficult to elicit any definite information; but the impression which their answers conveyed was that, now and then, they construct new circles, when they consider the old ones have been used long enough."

We have good accounts of these South Indian Circles by Messrs Walhouse[1] and Breeks.[2] The former describes them as taking the form either of huge masses of granite disposed in an exact parallelogram, or sometimes in squares, enclosing figures formed of smaller rocks. In the centre of some rises a tumulus, which excavation has shown to be sepulchral, or in some cases possibly sacrificial. The Kurumbas to this day worship their god Hiriadeva either in a cave or in a stone circle.[3] Mr Breeks speaks of one variety known as the "draw-well" kind, consisting of a dry circular wall. Others seem never to have been regularly built up, but are formed of a heap of rough loose stones, sometimes arranged more carefully on the inner side of the enclosure, or faced inside with larger slabs, but sloping outside into a tumbled heap. A third kind consists merely of a circle of stones, sometimes of long stones laid round on a sort of ridge sloping inward (which reminds us of Avebury), sometimes of rough stones embedded in the surface soil.

The modern circles are found in great numbers over all the hilly tract lying south of the Gangetic valley. Some which I have seen in Mirzapur are roughly circular, usually surrounding kistvaens. But the form seems to be in a great measure immaterial, and the Kol monuments described by Dr Ball[4] are merely irregular groups of standing stones. Through what period of time these people, or the tribes who handed the practice down to

1 "Journal Anthropological Institute," vii. 25.
2 *Op. cit.*, p. 73.
3 Breeks, *Op. cit.*, p. 53.
4 "Jungle Life," p. 163.

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them, may have erected these circles, no one at present can say.

One modern development of the circle, or possibly the utilisation of ancient monuments to serve a comparatively modern *cultus*, is seen in the Vetala circles of the Deccan. He is a demon lord, who twice a month at midnight, at full moon and no moon, wanders through the country like the Demon host of Teutonic mythology.[1] Lucky is the man who has the courage to address the demon, and crave a boon from him. The Vetala circle, of which there is a famous example on the Parvati Hill, near Poona, consists of a central stone, which is the god's house, and where offerings are made, and a circle of stones, each of which represents one of the host of goblins and deified spirits who act as guards to the demon.[2]

This last statement is particularly interesting when compared with the story which Aristotle tells of the Iberians,[3] that they used to place around the tomb of a dead warrior as many obelisks as he had killed enemies. We are reminded of the tales told of so many of our British standing stones, that they are petrified warriors, girls who danced on a Sunday, and so on. The Todas have a famous circle which they say consists of petrified soldiers, who insulted a priest: the angry ecclesiastic threw milk on them and turned them all to stone.[4]

In this view these lines of standing stones represent erections in which it is supposed the spirit of the departed takes refuge. This, I need hardly remind you, was the principle on which the most primitive form of altar was erected. We thus see why rude, uncarved stone was chosen for the early Hebrew Altar, as it was for the menhir, because the carving by the hand of man would

1 Grimm, "Teutonic Mythology," tr. Stallybrass, iii., 915 ff.
2 "Bombay Gazetteer," xviii., part iii., 388.
3 Windle, "Life in Early Britain," p. 54.
4 Breeks, *Op. cit.*, p. 36.

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be apt to scare the deity or spirit abiding in it. And hence, though some of the Indian races who raise these monuments are able to hew and carve, they naturally cling to the old traditional type.

Hence, too, we are able to understand the different views taken by some observers of the purpose of the Indian menhirs. Some have regarded them as funereal monuments; others say that they have no connexion with death rites, but are purely monumental. Both views may fairly be maintained. The Khasi monuments appear to be disconnected with the cult of the dead in so far as they are not usually erected over burial places or ossuaries. They are, as Major Godwin-Austen says,[1] "intended to perpetuate the memory of a person long deceased, who, as a spirit, has watched over or brought good fortune to a descendant, his family, or clan." The size of the monument depends "on the wealth of those who erect such mementoes, and on the benefit the deceased has conferred after passing into the world of spirits or demons."

This exactly supports the theory of the evolution of the menhir which I have suggested. Such a standing stone is in a way a memorial of the dead: but in its original intention, it is rather, as among the Khasis, the home of a spirit which has proved by its providential care of the interests of his family or clan that it is worthy of respect and propitiation.

These Khasi monuments have an additional interest in the fact that they enable us to realise how edifices like Stonehenge may have been erected by people possessed of few mechanical appliances. In erecting them all members of the community are bound to assist, and none, except the skilled stone-dressers, are paid. The others receive only a little food or beer from the family who are responsible for the monument. Hence, as among the Kols, the

1 "Journal Anthropological Institute," i., 126.

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magnitude of the monument largely depends on the amount of beer which the relations of the deceased are willing to provide. The stone is dragged to the site on a low wheeled truck provided with bamboo cables, to which numbers of men are harnessed. We may compare this with the method represented in the Egyptian tomb frescoes of the process by which the great statues and obelisks were conveyed. A hole is then dug with three vertical and one sloping side. Into this the end of the stone is slipped, and it is then hauled into an upright position by ropes. Prof. Gowland, from his excavations at Stonehenge, proved that the old British method was the same as this. That the Khasi method is effective is shown by the size of the stones which they erect in this way. Major Godwin-Austen[1] estimates the weight of one of their largest slabs at 21 tons. The stones of one monument, a trilithon, alone weighed 80 tons, and the highest individual stone seen by him was 18¾ feet high.

Another suggestive fact is that the Khasi monuments are built up gradually, and the work often extends over a series of years. This curiously corroborates the conclusions of Prof. Flinders Petrie, who, on purely metrological data, concluded that Stonehenge was constructed in the same way.

The most modern development of the menhir is found in the comparatively recent memorial stones and the Hindu Chhatris. The former is in the nature of our sepulchral monuments, and is intended to commemorate the death of some person of eminence, or of one who lost his life in some unusual or tragical way. In South India such monuments are known as Virgal or Virakal, "hero-stone." In one, described by Sir W. Elliot, the monument was erected to commemorate the death of a man killed by a tiger, and it attests that his wives committed suttee.[2] In

1 "Journal Anthropological Institute," i., 127.
2 Breeks, *Op. cit.*, 102.

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Western India such monuments are known as Palya, or "protective stones." There is a very fine collection of them at a place called Bhavsari, in the neighbourhood of Poona. One has an urn at the top, and below five panels ornamented with carved pillars. One panel represents a man lying dead with three cows above his body, showing that he was killed in a cattle-raid: above this is a representation of the hero with a spear, fighting two men armed with swords and shields; above is depicted the heaven of Siva, where the hero is being entertained by the celestial dancing girls.[1] In the Kathiawar peninsula hardly a village is without a memorial of the Bhat and Charan minstrels, who were put in charge of treasure in the old troublous times, and were bound in honour to die if their convoy was plundered.[2]

Similar stones, or in places where stones are not procurable, small masonry pillars are found all over the country erected in honour of the Suttees, or faithful wives, who used to die with their lords. On some is found a rude bas-relief showing the way in which the man met with his death; in others the widow is shown holding the head of her husband while both lie on the funeral pyre; in others both are enjoying the delights of heaven. In Rajputana, particularly, these stone monuments, known as Chhatris, are objects of great architectural beauty. Near the capital of each State, in a secluded spot, are collections of cenotaphs in the form of pavilions, usually erected on the spot where cremation took place, in honour of the princes and their queens who died with them. The great collection of these memorials at Udaypur forms one of the most beautiful cemeteries to be found in any country.[3]

1 "Bombay Gazetteer," xviii., part iii., 114 ff.
2 *Ibid.*, viii., 136 f.
3 Fergusson, "History of Indian and Eastern Architecture," 470 ff.

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I have thus endeavoured to sketch in its main outlines the tangled story of the Rude Stone Monuments of India. It will no doubt be disappointing to you to find that the Indian evidence throws little light on the age of the analogous monuments in Europe. But it is at least a warning against any attempt to make the evidence support any very definite conclusion. Where the evidence from India is really of value is, I think, that it helps us to work out the embryology and evolution of Rude Stone Monuments as a class. We see the series starting with the tumulus erected to restrain the ghost, and passing on to the dolmen and kistvaen, which attempt at the same time to provide for it the comfort which it enjoyed on earth; the circle marking the sanctity of the place of interment, or acting as a "ghost-hedge," originally part of the tumulus, and afterwards gradually isolated from it; the stone avenue evolved from the stone entrance of the underground tomb, and the trilithon a survival of its gateway; the menhir, an abode for the restless spirit, gradually becoming a mere memorial. All this may be pure guess-work, and may, as our knowledge increases, be replaced by some sounder induction from the facts patiently accumulated by the digger.

But, so far as it goes, it is of service in co-ordinating the great series of stone monuments with the cult of the dead as we find it among savages of our time; and it focusses our attention on the essential features of the problem, which we must solve before we begin to understand the origin and meaning of what, in Europe at least, are relics of a long-forgotten past.

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# SOME SUGGESTIVE NOTES

ON

# A DAILY WEATHER REPORT AND CHART

AND

# THE SYSTEM OF FORECASTING

BY

**A. S. HELPS**

(Read 14th March, 1905.)

Last autumn the Meteorological Society issued a circular suggesting the desirability of more attention being called to the work of the Society, and its recognition in a practical manner by an increase of its membership among such bodies as the Cotteswold Club.

I asked the Secretary to give us a paper which might forward this object, but distance was pleaded, and, at Mr Richardson's suggestion, I have endeavoured to fill the gap by putting together a few notes on daily weather charts and the system of forecasting.

The forecasting of weather is one of the oldest forms of prophecy, but it is one which is now, as more and more is understood of the conditions accompanying the incessant changes which have to be dealt with, gradually coming into the category of wise prophecy, *i.e.*, of what is known only.

Of all the instruments in use for the purpose, the barometer (invented about 180 years ago) is the principal

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mainstay of the forecaster. When I say the barometer, I do not so much mean any single one, and that without a continuous record, as is too generally used by individual observers.

The indications of a barometer, which are confined to the varying pressures of the atmospheric covering of the earth, only attain their true value when simultaneous observations over a large area (synoptic readings) can be collected and plotted on a map, and this is the grand advance which comparatively recent years (the last thirty years) have seen inaugurated, and which, of course, has only become available by the use of the telegraphic wire.

I would here enter an apology for reference to very elementary knowledge, and a disclaimer of original research, my notes, which are mainly suggestive of a closer study of the subject, being compiled from the works of Abercrombie, Scott, Reclus and other standard works, and papers read before the Meteorological Society.

I will assume it to be possible that rather hazy ideas are prevalent among many who have not given much attention to the subject, and that a few elementary observations may not be wholly out of place.

I remember, whilst looking at a daily chart in the passage of the Gloucester Club, (by the way, a very unsuitable, though rather common position for such charts, which cannot so be properly studied) being once asked by a passing member, an ex-mayor and magistrate: "Understandest thou what thou readest?" My answer was: "Oh yes, more or less." The word less hardly expressed his ideas on the subject: "still less" would have been near the mark.

It is important to get a clear idea of what a barometer can show us, and what it does not show: a subject on which some confusion is rather common.

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A mercurial barometer, which is the only really reliable one—all aneroids being more or less defective, especially in extreme readings—is constructed from a tube of glass 33 inches long, closed at one end, filled with mercury and inverted in a cistern of mercury, where it sinks to about 30 inches, the weight of which 30 inches is balanced by the pressure of the atmosphere when in an undisturbed condition at sea level. If that pressure becomes less, the mercury falls, if more it rises.

A high barometer therefore shows atmospheric pressure in excess of the normal.

A rising barometer: an increasing pressure.

A low barometer: atmospheric pressure below the normal.

A falling barometer: a decreasing pressure.

The engraving on an ordinary barometer should be regarded as being mainly for ornamental purposes only; it is not true that a low glass invariably means foul weather, and a high one fair weather.

A reading of set fair, *i.e.*, 30·10, has been shown with a south-west wind of a velocity of 62 miles an hour, and a gentle breeze from north-west (3 only) with a reading of 29·94; or, in other words, a heavy gale with a high barometer and a gentle breeze with a very low one.

The atmosphere is the outside covering of the globe, sometimes called the ocean of air, extending, at least, to a depth of 50 miles. This has been ascertained by a calculation of the refraction of the sun's rays at sunrise and sunset: it may extend in a very rarefied condition for many more miles, but, whatever its extreme limits are, it is much more susceptible than the water covering of the earth to the influences of temperature and the movements of the earth, and is subject to constant currents, tides,

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swirls and waves of motion, not necessarily extending to the surface, of which fluctuations we, living, as it were, at the bottom of a sea, can only judge by such knowledge as is attained by the observation of varying pressures shown by the barometer, and of changes in temperature shown by the thermometer, at the earth's surface, at sea level, on mountains, by balloon ascents, by kites, the explosion of shells into upper currents, and the observation of cloud movements, and in mines below the surface.

Without attempting any description of the general circulation of atmosphere over the surface of the globe, it may be sufficient for present purposes to refer to two main principles: that at the equator the atmosphere is warmed, and at the poles it is cooled, and that a stream of warm and lighter air is always flowing from the equator to the poles, and of cooler and heavier air from the poles to the equator, and that these currents are deflected by the varying velocities of the movements of the surface of the globe, which vary from over 1000 miles an hour at the equator to nothing at the poles. In this way a current starting from the North Pole and moving southwards, as it comes over a part of the globe travelling at 500 miles an hour, lags behind increasingly, and tends to become a north-east wind, and a warm current starting from the equator and moving northwards, at once and decreasingly lags behind, and is converted into a south-west or west wind.

Air starting southwards in latitude 25° N. moves eastward with the same velocity as that part of the earth's surface, but passes in its course over places travelling at a much greater rate, and is thus overtaken by them, and seems to come from the E. of N.

In the same way, when a steamship is travelling due east on its passage from Dublin to Holyhead, and the wind

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comes from the north, the smoke will trail off to the south-west, and, if the passengers on board are unconscious of any movement, the wind on board will be north-east.

The circulation of atmosphere thus existing gives rise, in parts of the globe, to more or less constant, or regularly recurring conditions, such as the trade winds, monsoons, etc., but, for our purposes, we may confine ourselves to the more complex, though less violent, manifestations (increases and decreases in the pressure of the atmosphere) which, in broad features, are recognised as cyclones, anti-cyclones, V depressions between two high pressures, colls, or necks of high pressure, between two cyclones.

Western Europe lies north of the calms of Cancer, and the prevalent winds are south-west (hence the "west end" of a town is the best end.) The main tendency, therefore, of circulation is to give westerly currents or winds, and these, coming over the Atlantic and the Gulf Stream, bring all our heat and moisture.

Synoptic readings over a sufficiently large area enable a forecaster to plot on a map the varying pressures existing over the whole area at a certain fixed hour, and by giving all the lines of equal pressure (Isobars)—which are calculated at the rate of fifteen nautical miles for one-hundredth of an inch shown by the barometer—the existence of areas of low pressure (cyclones), and of high pressure (anti-cyclones), in all their varying types become evident.

Of these areas of pressure, with their consequent circulation of winds, various types are recognised as more or less persistent during the various seasons, and depend, in the main, on the varying seasonal positions of large areas of higher and lower pressure over the Atlantic and North-Eastern Europe.

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The stations used by the forecaster for England are fifty-eight in number, and cover the whole of Western Europe, ranging from Bodö, within the Arctic circle, to the Azores, and from the coasts of Ireland to Berlin; and it may here be noted that the forecasts for the western side of this area present more difficulties than would be the case for Central and Eastern Europe, as in the main the weather in this hemisphere comes from the west, and no stations are available in the Atlantic.

In these islands four types of weather systems are recognised :—

1. The Southerly, in which an anti-cyclone lies to the east or south-east of Great Britain, while cyclones, coming in from the Atlantic, either beat up against it or pass towards north-east.

2. The Westerly, in which the tropical belt of anti-cyclones is found to the south of Great Britain, and the cyclones, which are formed in the central Atlantic, pass towards east or north-east.

3. The Northerly, in which the Atlantic anti-cyclone stretches far to the west and north-west of Great Britain, roughly covering the Atlantic Ocean. In this case cyclones spring up on the north or east side, and, either, work round the anti-cyclone to the south-east, or leave it and travel rapidly towards the east.

4. The Easterly, in which an apparently non-tropical anti-cyclone (or one disconnected with the tropical high-pressure belt) appears in the north-east of Europe, rarely extending beyond the coast-line, while the Atlantic anti-cyclone is occasionally totally absent from the Bay of Biscay. The cyclones then either come in from the Atlantic and pass south-east between the Sandinavian and Atlantic anti-cyclones, or else, their progress being impeded, they are arrested or deflected by the anti-cyclone in the north-east of Europe. Sometimes they are formed to

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the south of the Scandinavian anti-cyclone, and advance slowly towards the east, or sometimes, even, towards the west.

These types are so named because the prevailing wind in each is from South, West, North and East respectively.

The general idea of weather types will be readily understood by considering the fact, familiar to all observers, that the weather in this country frequently occurs in spells of several weeks' duration, in which time there is a remarkable persistence of the general type of weather, over-riding both a considerable fluctuation from day to day, and a considerable local variation from place to place.

For instance, the wind will often back to some point of south, with a high temperature, a dull sky, and rain, and then veer to some point of west, with a cooler air and brighter sky; and, after a day or so of fine weather, it will back again to the south with bad weather, perhaps this time rising to the intensity of a gale, and, subsequently, veer towards the west with finer weather, and so on for weeks at a time.

The changes only vary in intensity and detail, not in general character, while the feel of the weather and the look of the sky remain through all of them what are customarily associated with westerly winds.

Similarly, the wind will often come persistently from some point of east, fluctuating between south-east for fouler weather, and north-east for finer weather, and back again with many variations for several weeks, during which the predominant features of the weather are always characteristic of east winds. The frequent recurrence of particular types of weather at particular seasons of the year is also a matter of common observation: the north-east winds of March, the cold north winds of the middle of June, and the wet west winds of September are well-known instances.



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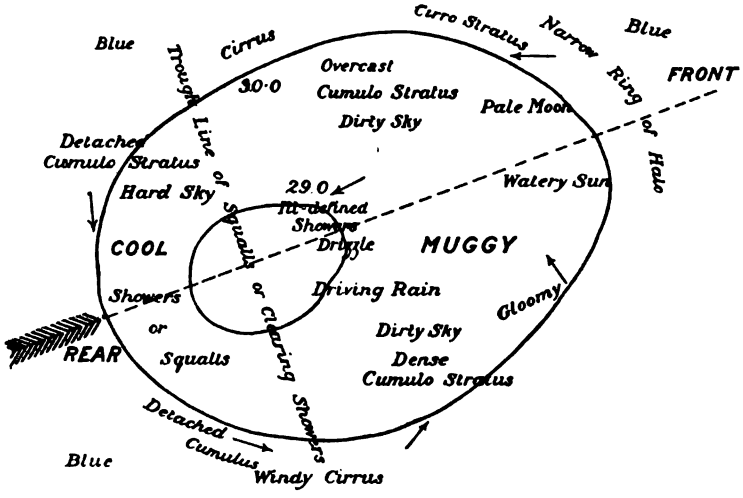
If we now consider the features of a depression or cyclonic area, we find (for details see plan) a large oblong area of low pressure, perhaps 1000 miles across its longer

*Cyclone Prognosues*




diameter, of which the main distinctive characteristics are: A circulation of winds over the whole area against the hands of a watch, inclined inwards towards the centre and upwards (hence the low barometric readings); warm, muggy and dirty weather in front; cool, dry and bright in the rear, there being an area of rain near the centre surrounded by a ring of cloud, both of which extend further to the front than to the rear of the centre. The cyclone is, also, divided into two well-defined halves by the line of "the trough," and the front may be further divided into the right or S.E., and left or N.E. fronts, which are separated by the line representing the path of the cyclone, which is almost invariably from W. or S.W. to E. or N.E.

An Anti-cyclone is an area of high pressure surrounded by nearly circular isobars. These are always a considerable distance apart, and spread over a large area. The

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pressure is highest in the centre, and gradually diminishes outwards. The air is calm and cool in the central portion, while, on the outskirts, the wind blows round the centre in the direction of the hands of a watch, not exactly parallel to the isobars, but spirally downwards (hence the high barometric readings) and outwards.

Unlike a cyclone, which is commonly in rapid motion, an anti-cyclone is often stationary for many days together. The broad features of the weather in an anti-cyclone are blue sky, dry, cold air, hot sun and hazy horizon, with very little wind—in fact the very antithesis of everything which characterises a cyclone.

Now, to return to our individual observer: he must have a barometer for reference and comparison, and, to be of any use, it should be one that gives a continuous record, *i.e.*, a barograph, and, as its record is differential only, it should be set to, and checked by, a standard barometer, and the readings be corrected to sea level, as all synoptic readings are reduced to sea level before being used for forecasting.

A week's register shows the reading for any hour at a glance. Eight a.m. is the hour for which the readings from all the stations of the Meteorological Office are collected by wire at the central office, and are there plotted upon a chart for consideration and use.

Now, if you take the daily chart, and, by means of a line drawn across it, translate it into a horizontal record, you will at once get a comparison with the readings of the barograph.

Suppose, for instance, as well might be, that the system shown takes a week to travel over a certain point, the comparison would be complete, and would show the weather which would, in that time, pass over the single observer.



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I give this as an illustration of the way, as it were, to correlate the horizontal record with the vertical scale chart.

In practice, what is necessary for an individual is to compare the barometric reading and other indications, when the chart comes to hand, with those at 8 a.m. on the daily chart, and the variations indicated enable him to see on the chart what changes are, probably, in course of development, or, in other words, where he now is under the system prevailing when the chart was prepared. Such and such a depression has filled up or increased, or an anti-cyclone is persistent, or slowly moving in a defined direction.

In considering the trace of a barograph certain refinements are possible which are of value, and should be noted, in making the individual forecast, which I take to be the object of every observer.

If the barogram changes at a uniform rate, either upwards or downwards, the resulting trace will be a straight line, either rising or falling, and it does not in the least matter how rapid the rise and fall is. If the rate of fall changes with diminishing pressure, the curve will become convex, or concave, according as the rate increases or decreases. For instance, suppose, as in the diagram, that the barogram fell two-tenths of an inch between one and two o'clock, and another two-tenths between two and three o'clock, the resulting trace would be a straight descending line like S; but if, in the second hour, the mercury fell three-tenths of an inch instead of two-tenths only, the resulting trace would be a convex like X, while if it fell only one-tenth in the second hour, the trace would be a concave as at A.

If we define the barometric rate as the number of hundredths of an inch which the mercury moves, either up or down, per hour, the above may be put in this form.

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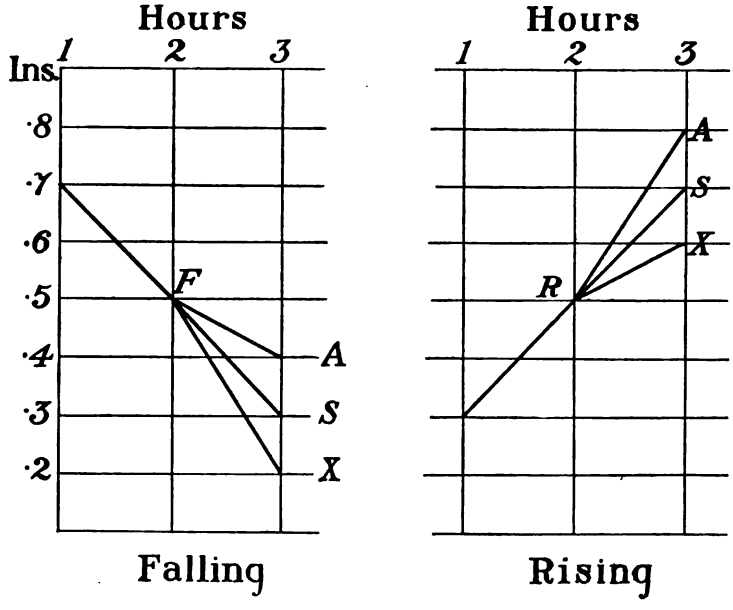
With a falling barometer the trace is convex for an increasing rate, concave for a decreasing one. A glance at the diagram will show that, for a rising barometer, the converse is the case; for when the rise is greater during the second than the first hour, the trace is concave as in A; but when less, then convex as at X; and this result may be stated as follows: with a rising barometer, the trace is convex for a decreasing rate, concave for




an increasing one. This is the reverse of what happens with a falling barometer. Now, the simplest and commonest case of barometric change occurs when the centre of a cyclone drifts past a station; the fall of the barometer is then proportional to the steepness of the gradients. When steeper gradients approach, the barogram will become convex; when slighter gradients arrive, the curve will be concave. The converse holds good for a rising barometer: when steeper gradients approach, the curve is concave; when slighter, then convex.

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Now, as the force of the wind is proportional to the steepness of the gradients, we find that the direction of curvature of a barogram tells us whether a gale is going to get worse or otherwise, because we can tell if the gradients are becoming steeper or otherwise. We must be very careful to remember that, though a rapid rate of fall is in a general way a worse sign of weather than a moderate one, the indications, deduced from the curvature of a barographic trace, depend on the variation of the rate, and not on the rate itself.

The cultivation of, and deductions from, the varying conditions personally experienced is an interesting feature which I do not remember ever having seen enlarged upon, although the extent to which existing conditions, as affecting the individual, may, in conjunction with instrumental observations, be realised and estimated is capable of much refinement.

Everyone feels how cold and uncomfortable a March east wind is, and how hot a day is marked by 84 in the shade, but, with care, attention and practice it is quite possible very much to refine upon such general experiences.

In the question, for instance, of atmospheric pressure, is it not easy to recognise a very high glass with its bracing and tonic effects? This may be done before breakfast, and while dressing you will, of course, see where the wind is, and consider the clouds, and so much of the sunrise as you are wise enough to be awake for.

If you have a bedroom with a large bay window, you may learn something, in hard weather, from the varying degrees of frost on the different exposures, and the direction from which rain or snow has come. On a question of temperature (perhaps the most easily recognised condition), your bath (without the extreme of breaking ice, or trying to use a frozen sponge) will give you some

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indication, and then, when downstairs having looked at the barograph, if you use your wits, a walk, especially in thin shoes, of 200 yards, over gravel, grass and turned-up garden mould, will enable you, remembering or referring to yesterday's temperature, and recognising and valuing all personal and other indications, to say, within a degree, what reading you will find in the screen.

There is a satisfaction in doing this right for several days together, perhaps even to one degree, and when you go wrong by 5° or more, you may put it down to some cause not sufficiently recognised and estimated, and learn to do better; you must, also, expect to find your perceptions varying with, and indeed largely dependent upon, a fairly healthy state of body and mind.

The rainfall can, also, by observation of the tread of the soil, be estimated, and, in a time of much rain, it is easy to judge the number of hundredths of an inch in the bottle before measuring it in the small glass.

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In the course of a discussion, which followed the reading of these notes, Mr Embrey drew attention to a conclusion which he had arrived at, by a study of a long series of weather charts, viz., that when a system of parallel isobars from east to west are shown, an uncertain forecast will follow, and constant changes may be expected; but that if the isobars are north and south, and there is an anti-cyclone to the west, then settled weather will follow. But it is important that the isobars should show a regular curve; for, if they are indented, secondary cyclones are indicated, and uncertain weather will follow.

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| Subscriptions to 3rd April, 1906 ... ... ... | 97 10 0 | |
| | | 111 3 9 |
| | | £182 6 5 |

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## APRIL, 1905, TO 3RD APRIL, 1906.

### PAYMENTS

| | £ | s | d | £ | s | d |
|---|---|---|---|---|---|---|
| Secretary's Expenses ... ... ... ... ... ... | | | | 7 | 18 | 1 |
| J. Bellows, Rent of Room ... ... ... ... ... | | | | 12 | 0 | 0 |
| Carriage of Parcels ... ... ... ... ... ... | | | | | 11 | 4 |
| Treasurer's Expenses (two years) ... ... ... ... ... | | | | 1 | 5 | 6 |
| H. H. Michael, Lithography ... .. ... ... ... | | | | 3 | 3 | 0 |
| West, Newman & Co. " ... ... ... ... ... | | | | 1 | 5 | 2 |
| Limelight ... ... ... ... ... ... ... ... | | | | 1 | 3 | 0 |
| J. Bellows, on acct. of Printing Proceedings (for two years) ... | | | | 55 | 12 | 9 |
| Municipal Schools, Use of Room for Meetings ... ... | | | | 2 | 17 | 0 |
| Custodian ... ... ... ... ... ... ... ... | | | | 1 | 2 | 8 |
| Coffee Co., Refreshments ... ... ... ... ... ... | | | | 4 | 0 | 0 |
| Norman, Sawyer & Co., General Printing, &c. ... ... ... | | | | 12 | 6 | 0 |
| BALANCES— | | | | | | |
| At Deposit Account, Capital and Counties Bank | 54 | 1 | 8 | | | |
| " Current Account " " " " | 16 | 3 | 4 | | | |
| In Secretary's hands ... ... ... ... | 1 | 1 | 11 | | | |
| " Treasurer's " ... ... ... ... | 7 | 15 | 0 | | | |
| | | | | 79 | 1 | 11 |
| | | | | £182 | 6 | 5 |

A. S. HELPS, *Hon. Treasurer.*

Audited and found correct, 20th April, 1906
H. KNOWLES.

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## RULES OF THE CLUB

1.—The Objects of the Club are to study the Natural History and Antiquities of the County and the adjacent districts.

2.—The Club shall consist of a President, Vice-Presidents (not exceeding seven in number), an Honorary Secretary, an Honorary Treasurer, and Honorary Librarian, and Honorary, Ordinary and *Ex-officio* Members.

3.—Before anyone can be elected a Member he must be duly proposed and seconded at an Ordinary Meeting, and come up for ballot at a subsequent Meeting; one black ball in ten to disqualify.

4.—The Entrance Fee shall be £1. The Annual Subscription of Ordinary Members shall be Fifteen Shillings, due in advance on the first day of January.

5.—Any Member in arrear with his Subscription for the year is liable to removal from the list of Members.

6.—No Member shall be entitled to a copy of the Proceedings whose Subscription is one year in arrear.

7.—The Club may admit a limited number of Honorary Members (see Rule 2), whose scientific work entitles them to the distinction, and who must be elected at the Annual Meeting.

8.—The Executive Council for the Management of the Club shall consist of the President, Vice-Presidents, the Honorary Secretary, the Honorary Treasurer, and Honorary Librarian, all of whom shall retire at the Annual Meeting, but are eligible for re-election.

9.—The Annual Meeting shall be held in the early part of each year, at which Meeting the President's Address shall be read, the Financial Statement of the Honorary Treasurer shall be presented, and the Officers shall be elected, and the dates and places of the Field Meetings be fixed; but the arrangements for the Winter Meetings shall be left to the Executive Council.

10.—The Club shall usually hold yearly four Field Meetings, and also four Winter Meetings for the reading and discussion of Papers. At the Field Meetings any Member may introduce one Visitor, and at the Winter Meetings more than one; and at the Winter Meetings the term "Visitor" may include ladies. Members must give due notice to the Honorary Secretary of their intention to be present at any Field Meeting, and should any Member, having given such notice, fail to attend, he will be liable for his share of the expenses.

11.—The Council may at any time call a Special General Meeting of the Members. Upon the requisition of any eight Members being sent to the Honorary Secretary, a Special General Meeting shall be convened; and any proposition to be submitted shall be stated in the Notice. Not less than seven days' notice of any such General Meeting shall be given.

12.—The Club shall use its influence to promote the preservation of all antiquities and to prevent, as far as possible, the removal of scarce plants and the extermination of rare species of the flora or fauna.

Adopted at the Annual Meeting of the Members at Cheltenham, April 27th, 1896; and revised at the Annual Meeting at Gloucester, April 23rd, 1901.

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# PROCEEDINGS

OF THE

# COTTESWOLD NATURALISTS' FIELD CLUB

AT THE

# ANNUAL GENERAL MEETING

APRIL 3rd, 1906

REV. WALTER BUTT, M.A., PRESIDENT

IN THE CHAIR

---

A. Slater and Vincent A. Smith, M.A., I.C.S., (Retd.), were elected Members.

The Minutes of the last Annual General Meeting were read and confirmed.

The Hon. Treasurer presented his Financial Report, which was approved, and showed that the Club was in a satisfactory condition (pages xxviii-xxix.).

## THE ANNUAL ADDRESS

OF THE

## PRESIDENT

**The Rev. WALTER BUTT, M.A.**

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I was able to say this time last year that the Club numbered 100 ordinary members: this year we are 103. Our progress therefore has been well maintained. There



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are some who say—and one at least who says it is worthy of attention—that we shall have before long to limit our numbers. Sufficient unto the day is the evil thereof! When the number of those joining the Field Meetings becomes unwieldly—let us say when it is always nearer 40 than 20—perhaps the Council may have some proposition to bring before their fellow members. But that will not be just yet. May I live to see, not a limitation of numbers, but some arrangement made whereby congestion is dealt with whenever it shall arise. Shall Gloucestershire men fail, where Herefordshire, Somerset and Dorset men succeed? I am myself a member of several Field Clubs, whose Meetings are much more largely attended than our own, and it always seems to me that numbers at the place of assembly and at any subsequent trysting place make for enthusiasm, and an honest rivalry to be at least equal to one's fellows in the loading up of wallet or vasculum. But I speak with a conviction that may be begotten of ignorance.

By death we have lost an honorary Member—Mr Taylor, the well-known "H.Y.J.T." of the local Press. He was a most remarkable man, a strenuous worker, and never happier than when making researches into local history and tradition by means of newspaper files and such like somewhat dry and arid sources of information.

By resignation we lose seven members. Dep.-Surgeon-Gen. T. Ringer unfortunately felt constrained to resign owing to continued ill-health. He was formerly a constant attendant at our meetings, and we have missed him. Dr James Berry, Mr T. Dyer-Edwardes, Rev Robert Hall, Col. A. W. Jamieson, Messrs H. C. McLaughlin and J. R. L. Rankin, and Captain A. Ryves are the others who have retired—the majority on account of being unable to attend the meetings of the Club.

As, however, a number of new Members have joined us, we have been able to maintain and exceed our last

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year's number. Amongst the new Members, several, if not all of them, are well-known to many of us as having done good work in fields which lie within the scope and sphere of Naturalists. Some indeed bear attestations after their names to their having gained the approval of the State when serving her, or that of examiners in Art or Science, and of the members of learned Societies—we welcome their coming among us with a firm expectation that they will enhance the reputation of the Club.

We are a Scientific Club—not a social one. And though far be it from me to say that only scientific men should be elected—for *that* were barring an outlet through which many a one dungeoned in the darkness of ignorance might escape into the light of fuller knowledge—yet I do say that if Science knocks at our door in the person of her humblest born son, the knock should be like the "Open Sesame" of romance, and admittance forthwith granted.

I turn to what has been done by some of our Members as evidenced by their published works. But naturally much of this escapes even the eyes of our Secretary. It would save him much trouble if the Members would communicate the titles of any paper or book they may publish.

Mr S. S. Buckman has published, Part XIII of "A Monograph on the Inferior-Oolite Ammonites of the British Islands" *(Pal. Soc. 1905)*; a paper "On Certain Genera and Species of Lytoceratidæ" *(Quart. Journ. Geol. Soc. vol. lxi., 1905)*; and one on "The Nomenclature of Types in Natural History," in collaboration with Dr Charles Schuchert of Yale University, in "Science," in America, in the "Annals and Magazine of Natural History," in England, and it has also been translated into French and published in the "Archives de Zoologie." He



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has also made additional contributions to the "Palæontologia Universalis."[1] Dr C. Callaway has shown in his "King David of Israel,[2]" what a fluid thing is morality as known to, and practiced by, mankind—even the best of it. The standard of yesterday is not that of to-day, and *that* will not be the one of to-morrow. The Rev John Evans has published a new edition during the past year of his "History of the Ancient Britions"—a work which has earned the commendation of many, and is scrupulously fair. Mr G. W. Hedley has published, with a collaborateur, a work on "Chemistry for Elementary Students," and also "Rudiments of Chemical Theory." Dr E. W. Prevost has published (Henry Frowde, London, Price 10/6,) a supplement to the "Glossary of the Dialect of Cumberland." It contains another chapter on the Grammar by S. Dickson Brown, M.A., whilst our Member is responsible for additions to the list of local names of plants, birds, fish and insects, and information concerning several obsolete customs, similes, and proverbs.

Our Honorary Secretary, in continuation of his work on the Rhætic, has published papers on "The Rhætic Rocks of Monmouthshire" *(Quart. Journ. Geol. Soc., vol. lxi., 1905)*; "The Rhætic and Contiguous Deposits of Glamorganshire" *(idem)*; and "On the Occurrence of Rhætic Rocks at Berrow Hill, near Tewkesbury" *(idem)*. He has also contributed three papers to the Transactions of the Woolhope Naturalists' Field Club.

I myself, in a very humble way, have been of some assistance to the Wiltshire Archæological Society in working out the history of that extraordinary stone, which

[1. This is a most valuable work. It is proposed, and considerable progress has already been made, to reproduce the original figures and descriptions of all type-fossils and to obtain the assistance of specialists in re-figuring and adding comments on the same. Mr Buckman has in this way dealt with many fossils which were figured and briefly described in the 1844 edition of "Murchison's Outline of the Geology of the Neighbourhood of Cheltenham, Augmented and Revised by H. E. Strickland, M.A., F.G.S., and James Buckman, F.G.S."—Ed.]

2. "King David of Israel: A Study in the Evolution of Ethics."

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we saw some years ago on the wall of Oaksey Church. There are only five or six *bona fide* examples in England and Wales of this particular form of Nature-worship, namely, that of the female organs of reproduction, though there are forty in Ireland. Payne Knight in his "Worship of Priapus," a singularly scarce book, gives several illustrations of the Sheela na Gig, identical with the Oaksey example, and in the third volume of the late Major Forlong's "Faiths of Man"—alas that it has had to be published now by his Executors—other examples are noted.

Mr Sawyer was most helpful to the Members of the Gloucester and Bristol Archæological Soceity when they visited Cheltenham last summer. As one whose book on the Parish Church of Cheltenham is a classic, his remarks upon that really lovely building were much appreciated.

As I am upon the subject of Literature, I cannot refrain from mentioning that charming book by Messrs Davie and Guy Dawber upon the "Cottages and Farm Houses in the Cotswold District." The possession of such a book is a pure delight.

"The Highways and Byways in Oxford and the Cotswold" by H. A. Evans—to go from a book of true art to a mere Guide Book—seems to me trustworthy and useful.

And with the promise not to mention any other book connected with the district from which we take our name —though sorely tempted to do so, for it seems almost invidious to pass over the charming description of Burford in Canon Hutton's "Burford Papers," and Harper's "Oxford, Gloucester and Milford Haven Road," which takes us through the heart of our County, and the new edition of Leland's "Itinerary," with its quaint account of 'Ciceter—I feel bound to draw your attention to that most interesting book published by Mr Ashbee, and

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printed with quite exceptional skill by the Guild of Handicraft at Campden, entitled "The Last Records of a Cotswold community." If the book can now be got—which is doubtful—I advise its purchase if only as a form of investment.

In the foregoing remarks, I have used the word "Cotswold" frequently and of necessity. Apart from the spelling, which is a thing that confessedly has no definity about it—*with* two "t's" and an "e"—as we of this Club spell it—with two or one "t," but without any "e"—apart I repeat from this, are we to change our views as to the derivation of the word? I almost feel the ground cleaving under me. I thought we had πού στῷ in the derivation from *Coed*, a wood. And though it was a bit staggering—despite the many other similar instances—of a duplication of the word "wood" in the termination Wold—yet one felt secure, and flew with fury at the throats of the sheep-fold theory men. Now it seems, if Mr Duignan is to be trusted, we must go to one Cod as the source of our word—a landowner and chieftain of fame indeed if he has given his name to that large district which we claim as our own. But please see, as to this, the author's remarks in his "Place Names of Worcestershire." And if he will but extend his researches to our own County, generally, we shall owe him a deep debt of thanks.

From books, to the care of them, and the places where to keep them. *Our* Library is hardly the object of interest or use to the Club that it should be. A Catalogue was much needed, and this was prepared in manuscript by our Secretary. The Council flinched from the cost of printing it, even though their doing so might look like a slight upon the really admirable and painstaking work of our Secretary. Then came in, too, the question whether it was really worth while to publish a Catalogue which, if it was to be a complete one, would have to contain the titles and

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subjects of a mass of pamphlets and publications from American Scientific Societies. A more modest plan has been determined upon, and Mr Richardson has in preparation, with a view of its being forthwith put in our hands, a catalogue giving all the information as to the contents of our Library which is likely to be wanted by those who would use it. Probably such a catalogue will bring the value and usefulness of our stock of books more into prominence. But I should like to see the Library grow, and I throw out the suggestion that the Club should make an annual grant to the Council to be spent in books. It would be, I believe, money well laid out. Much might be done with even so small a sum as £5 per annum.

The meetings, both Field and Winter, have been well attended. This is most gratifying. The Members, however, are doubtless aware that if the doings of the Club at these meetings are not chronicled in the President's Address there is no permanent record. This seemed unfortunate, so after deliberation the Council thought it desirable to make an innovation, namely, to have full reports of the Field Meetings and brief notices of the Winter Meetings published. This idea has been carried into effect in the present part of the "Proceedings" (see pp. 175-199). I would, however, briefly review our proceedings at these meetings.

First we went to Bath, where under the able leadership of Mr Winwood an instructive day was spent. Fortunately we were not hurried for time during any part of the day, and this in itself made for pleasure. The same thing may be said of our other three whole-day Meetings. We were not rushed at any one of them. It was a matter of regret that the attendance of Members at this Bath Meeting was less than at any of the others; for the place is one of such extreme interest, that it never can be visited too often. But as a fixture it does not seem to gain the

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favour of our Members. It is on record that some few years since, only six or seven Members attended a Meeting held there. Probably most of our Members know the place well, and we must look to that fact as the reason for a thinner attendance than at our other Meetings, which as I have said before were conspicuously well patronized. The Roman Baths, and modern Pump Room were visited, and some of us looked with the interest which it deserved at that very cryptic letter of Venisius to Nigra, one of the most difficult pieces of writing to decipher which students of palæography have been faced with. After lunch, a gravel-pit, in which mammalian remains had been found, and fragments of rocks from far distant places, was visited, as also a section of Lower Lias. Then came the Abbey with all its memories, not least perhaps being that one which brought before us, as having taken place within the walls of its predecessor, the first coronation of an English King of which we have anything like a minute description, I mean that of Eadgar in 973.

Our second Meeting at Lavernock, near Cardiff, was very well attended. A more enjoyable day can seldom have been spent by the Club, or a more instructive one. Mr Richardson as usual had all the geological features at his fingers' ends; so that on our walk to Sully our attention was being constantly called to the quite unusually numerous varieties of beds exposed. To such an ignoramus as myself, the sections, owing to their very number and diversity, were quite bewildering. Keuper, Rhætic, White Lias, Lower Lias, Paper Shales, and Dolomitic Conglomerate, what did we not see between our pic-nic lunch, and equally pic-nicky tea at Swanbridge Farm.

The Wotton-under-Edge District next claimed us, and a pleasant Meeting was held. The Carboniferous Limestone and Old Red Sandstone at Wickwar were inspected

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by us, and to the delight of many of us, a capture of certain out-of-the-way spiders or mites—*Tetranychus lapidum*—was made in the Limestone Quarry by that well-known entomologist, Mr Watkins, of Painswick, who happened to be the guest of one of our Members. More entomological work should really be done by the Club, if its right to the title of a Naturalists' Club is not to be denied to it. From Wickwar we fared on to Hawkesbury Church, a *most* interesting building, and to the Monument erected in 1846 to General Lord Edward Somerset. On the road was passed a fine colony of that not generally common alien *Sambucus ebulus*. At the Monument lunch was taken, and then a discussion was held as to the advisability of the Club undertaking the preparation of a County Flora. But of this more anon. We then drove to Mr Hannam-Clark's bungalow at Kilcott, where we were hospitably entertained at tea. On the drive to Charfield Station, the beautiful 15th Century gateway of the famous Cistercian Abbey at Kingswood, was passed. The Abbey was founded first in 1158 and, after migrations to Rodmarton and Tetbury, was re-established in 1179, and colonized from Tintern.

With a visit to Hereford we closed our summer Meetings, and a day of distinctly varied interest was spent. The palate of the literary man was catered for, while the archæologist and geologist were not by any means forgotten. The number of Members attending was most satisfactory. We first visited a Glacial moraine, or rather—though I speak under correction—the remains of one, much redistributed by subsequent river-action. Our able guide was the Rev H. E. Grindley, its discoverer. Here there was a good deal of discussion, far more than, in late years at any rate, usually takes place at any exposure or section. Undoubtedly there were sceptics, and perhaps such they would have remained, had not Mr Grindley been able to

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show actually striated rocks. He had a strong supporter in Dr C. G. Cullis. The visit to this moraine cannot but have interested the Members of a Club which in their own district have so few, if any, evidences of the Great Ice Age, or one of those ages. After lunch at the Green Dragon Hotel, Mr Moore took us kindly in hand and led us to one of the most famous libraries in England. The collection of chained books, in their original cases, has no equal in Europe. Some of the Manuscripts in the Library are of exceeding beauty, notably an Anglo-Saxon Copy of the Gospel, of perhaps the 8th Century. Anyway it was reckoned as *old*, when, in 1050, it was bequeathed to the Bishop of Hereford. The best thanks of the Members present were given to Canon Williams, who piloted us through the treasures of his Cathedral Library. The Cathedral itself was then entered, and its characteristic features pointed out by a verger who was something more than the repeater of a cut-and-dried description. Those who affect to despise Hereford Cathedral are surely wrong. It is beautifully situated, rivalling Salisbury and Wells in this respect, and it can show specimens of every style of Architecture from Norman downwards. Not a little time was spent in looking at the very curious *Mappa Mundi*, drawn by an old Lincoln monk in the 13th Century. I think he might have done better if his knowledge of geography, however crude it were, had not been overborne by his piety. There was time for a visit to the Public Library and Museum where are the head-quarters of our sister society, the Woolhope Club—quarters which made us of the Cotteswold Club envious. And then, with no sense of fag or time mis-spent, the journey home lay before us.

Thus for the four principal Meetings of the Club.

Half-day Excursions were made to Cooper's Hill and the Roman Villa there, on June 10th, on which occasion Mr

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Cullis most kindly gave tea to a numerous company; and to Leckhampton Hill, on July 8th. I cannot help thinking that these minor Meetings have a very real purpose and tend to the strengthening of the Club.

And now a word or two about our Winter Meetings, the last of which was held but a fortnight ago. They have been well attended and many interesting specimens were exhibited at them, notably several geological ones brought from Cyprus by Col. Duke, and those collected by Mr Upton in Labrador. Our Secretary, Mr Winwood, and many others, were also good enough to exhibit to us botanical, geological, and other specimens.

I was not myself able to remain in Gloucester a longer time than would suffice for me to attend the Council Meeting on January 9th, so I missed hearing the valuable lecture by Mr Vincent Smith, upon "Pygmy Flints." When anyone is ready to discourse upon a subject about which so little is known, our best thanks are due to him, and I am thankful that in my absence so capable a Chairman as Mr Winwood was present to render those thanks to Mr Vincent Smith.

Professor C. Lloyd Morgan, F.R.S., found time to come here on February 20th, to give us one of those charmingly lucid lectures of his upon "Instinct." None of those who heard him can have gone away with other than a mind illuminated. The subject is notoriously a dark one, and without guidance one may get easily beyond his depth. Professor Lloyd Morgan having promised to give us his opinion as to where Instinct ended and Reason began, in another lecture, our gratitude to him was sincere, based as it was (for in this all gratitude is said to consist) upon a keen sense of favours to come.

Our last Meeting afforded us an opportunity of hearing a very short abstract of a paper by our former Secretary, Mr Buckman, upon the species of Liassic Ammonite

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Genus, *Schlotheimia*. The Paper was clearly a most valuable one, and is published in this part of our "Proceedings."[1] And Mr Cullis treated, not without humour, of a navigator's experience when making up our river to Gloucester.

I have left purposely our first Winter Meeting to be the last dealt with. The inception of the idea of the Hawkesbury luncheon hour matured into fact at this meeting, when steps were taken to carry into effect a proposal of my own which urged the appointment of a Committee to prepare materials for the publication of a County Flora. We had invited botanists generally to attend this meeting in the hope that they might strengthen us with their council and promise us help. We were fortunate in securing the attendance of several leading botanists from our own County and Bristol. Mr White, author of the "Flora of the Bristol Coal-Basin," came as representative of the Bristol Naturalists' Society, and promised us his own active support and that of his Society. Mr Priestley of University College, Bristol, gave us his presence, as also did Miss Laurie from the Cheltenham Ladies' College. And both of these, with of course our own Members having botanical tastes and knowledge, readily placed their services at the Club's disposal. Mr Coley, a host in himself, who had done work for the Victoria County History, Mr W. L. Mellersh, Mr J. W. Skinner, Mr W. Thompson, the Hon. Secretary and myself were placed on the Committee. This Committee has got to work, and if as I hope, Father Reader of Woodchester Priory, can be secured, if indeed he be not already secured, as General Editor, I personally have every confidence that in due time that much wanted work, a Flora of our County, drawn up on thoroughly exhaustive lines and upon a scientific basis, will be obtainable, and that it will be the offspring of the Cotteswold Club.

1 See p. 231

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As a Gloucestershire man, it has always given me a turn to see my bookshelves without a County Flora, whereas those for Wiltshire, Somerset and Hereford, to name but three, stare me in the face. And when one has to notice that those Floras were all brought out by Societies similar to our own, but of later birth, a kind of feeling of shame has at times come over one.

Of course we must have patience, and may be others will enter into the labours of us of to-day. But I have every confidence that the seed sown during the years in which I have had the high honour of being your President will sooner or later result in a worthy harvest.

The Rev Walter Butt, then left the Chair, and proposed Mr W. R. Carles, C.M.G., F.L.S., F.R.G.S., as President. This was seconded by Dr C. Callaway and carried unanimously.

Mr Carles returned thanks, expressing his appreciation of the high honour the Members had conferred upon him. The Rev H. H. Winwood, M.A., F.G.S., Messrs E. B. Wethered, F.G.S., Christopher Bowly, M. W. Colchester-Wemyss, Dr C. Callaway, M.A., F.G.S., the Rev Walter Butt, M.A., and Mr Charles Upton, were elected Vice-Presidents; Mr A. S. Helps, Hon. Treasurer; Mr F. J. Cullis, F.G.S., Hon. Librarian; Mr L. Richardson, Hon. Secretary, and Mr E. Talbot Paris, Hon. Assistant Secretary.

It was decided to hold the Field Meetings at the Lickey Hills, near Birmingham, May 25th; Stroud (half-day), June 2nd; Dursley, June 19th; Wainlode Cliff (half-day), July 7th; Bourton-on-the-Water, July 24th, and 25th; Forest of Dean, September 11th.

A. J. Stephens was elected a Member.

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# ORDINARY WINTER MEETINGS

TUESDAY, NOVEMBER 14th, 1905

REV. WALTER BUTT, M.A., President, in the Chair

The following communication was read:

"A COTTESWOLD BRACHIOPOD: A FORGOTTEN NAME AND A NEGLECTED AUTHOR." By *S. S. Buckman.*[1]

The President then initiated a discussion on the desirability of having a Flora for the County—a matter he had brought before the Members at the Hawkesbury Meeting. Mrs Hutton and Miss Mary Hutton, of Harescombe, Miss Laurie, of Cheltenham, and Messrs J. H. Priestley and J. W. White, F.L.S., of Bristol, attended. It was unanimously decided to prepare a Flora, and the President, Hon. Secretary, and Messrs S. J. Coley, W. L. Mellersh, J. W. Skinner, and W. Thompson were appointed a Committee, with power to add to their number, and it was hoped that it would be possible to obtain the services of the Rev. H. P. Reader as General Editor.

TUESDAY, JANUARY 9th, 1906

REV. H. H. WINWOOD, M.A., F.G.S., Vice-President, in the Chair.

The following were elected Members of the Club: A. Cockshott, R. M. Cole, and D. E. Finlay, M.B., B.S.

The following paper was read:—

"PYGMY FLINTS." By *Vincent A. Smith, M.A., I.C.S. (Retd.)*[2]

TUESDAY, FEBRUARY 20th, 1906

REV. WALTER BUTT, M.A., President, in the Chair

E. Talbot Paris was elected a Member.

A lecture was delivered by *Prof. C. Lloyd Morgan, LL.D., F.R.S., F.G.S.*, on "INSTINCT."[3]

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TUESDAY, MARCH 20th, 1906

C. CALLAWAY, M.A., D.Sc., F.G.S., Vice-President, in the Chair

The following communications were made:

1.—"SOME LIAS AMMONITES: *Schlotheimia*." By *S. S. Buckman, F.G.S.*[1]

2.—"NOTES ON SOME NATURAL CONDITIONS AFFECTING THE LOCATION AND STORY OF GLOUCESTER." By *F. J. Cullis, F.G.S.*[2]

Dr. C. Callaway exhibited rock-specimens, which Mr Upton, who was unable to attend, had collected in Labrador. They included Norite (Labrador felspar and hypersthene or an allied mineral), mica-gneiss, and other crystalline rocks similar to those of the Malvern Hills and the Hebrides.

## EXCURSIONS

### EXCURSION TO BATH

TUESDAY, MAY 16th, 1905

*Director:* REV. H. H. WINWOOD, M.A., F.G.S.

(*Report by* W. THOMPSON; *revised by the* DIRECTOR)

The first excursion of the Club was attended by the following Members:—Rev. Walter Butt (*President*), Messrs W. Bishop, W. Crooke, F.A.I., F. J. Cullis, F.G.S., G. M. Currie, C. E. Gael, O. H. Fowler, G. W. Keeling, W. Margetson, J. W. Skinner, A. Slater, W. J. Stanton, W. Thompson, Col. D. O'C. Raye, Surgeon-Major T. Newton. Mr Waterhouse of New Zealand came as a visitor.

In the absence of Mr Richardson, the secretarial duties were ably carried out by Mr Cullis. The party was met at the Midland Station by Mr Winwood, and conducted to the Pump Room and Baths, free admission to which had been courteously conceded by Mr Moore, the Chairman of the Baths Committee, who unfortunately was prevented from being present by indisposition. Mr Winwood first recalled the dates of previous visits. In 1864 the British Association met at Bath, and at that time the Cotteswold Club was in all its glory, and shared in the enjoyment of the meeting. Two years later, however, when the Club again went to Bath, only six or seven members attended. In 1881 Mr Handel Cossham was the guiding spirit, and in 1892 Mr Winwood took charge of the party. In 1898 Mr Bellows read a paper on the Baths, and they all regretted he was no longer alive to instruct and interest them on a subject which he had made

1 Page 231 2 Page 253

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peculiarly his own. The speaker reminded his hearers that they were now standing near some of the most remarkable Roman ruins that England could produce. The piers which formerly sustained the roof showed how massive and strong must have been the structure in its original state. Mr Winwood related how the Baths came to be discovered, and how the Corporation undertook the work of excavation. Opinion is divided as to whether the pool itself was sheltered by a roof, but there is no doubt that the corridor which surrounds it was covered in. After the Romans retired from Britain the Baths dropped into a state of decay, and became covered with a lacustrine deposit. From this was recovered a teal's egg, which is now exhibited with other relics in the Pump Room. It may be mentioned that the water from the thermal spring, which in a great measure has made Bath famous, remains invariably at a temperature of 117 degrees. There is no doubt that the Baths were of a very considerable size, and the remains cannot fail to excite the interest and admiration of those who behold them. Bath was known to the Romans by the name of Aquæ Solis, and the latter word at first suggests as the meaning of the name "Springs of the Sun." It has been pointed out, however, that inscribed stones dug up at Bath show that there was a deity worshipped there under the title of Sul Minerva, and that in all probability the word is preserved in Aquæ Solis.

After making a tour of the Baths, the party ascended to the Pump Room, where some of the members treated themselves to a glass of water preparatory for lunch, which was served at Fisher's restaurant. From the restaurant the Members were driven to a gravel-pit near Oldfield Park, where some mammalian remains were recently discovered. Mr Winwood amused the company by explaining that some workmen were very excited when they discovered what they took to be an elephant's tail. They were quite sure it was a tail because it was "curled right round." However, it turned out to be a tusk of *Elephas primigenius*, portions of which were scattered about. This mammalian gravel, situated about 100 feet above the present river, is of a very different description from that associated with the present bed of the Avon, for so far from the river cutting out a deeper bed, it seemed to be engaged in the task of getting choked with mud. In the gravel-pit are found pieces of sarsen-stone, flint, Carboniferous Limestone, Old Red Sandstone, &c., thus suggesting that the river flowed with a strong current, and brought material from distant places.

From the gravel-pit the party were driven to a fine section of Lower Lias capped with gravel, at the Victoria Brick and Tile Company's works at Lower Twerton. Here some climbing had to be effected on a yielding bank of dislodged gravel, and when it is mentioned that a fence of barbed wire had to be negotiated at the top, readers will see that elderly gentlemen, at all events, had their work cut out. The exposure of Lower Lias clay is very extensive, but so far it has not yielded many fossils. The same holds good with regard to the superimposed gravel, in which Teeth of *Elephas*



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*primigenius* have been found. Fragments of brachiopods are present, but nothing of importance was picked up during the examination.

At the close of the day's proceedings, Mr Winwood was thanked for his services, and in responding, he said his only regret was that so few Members had found it convenient to be present.

H. L. White, B.A., was elected a Member.

## HALF-DAY EXCURSION TO COOPER'S HILL

### NEAR GLOUCESTER

SATURDAY, JUNE 10th, 1905.

*Director:* F. J. CULLIS, F.G.S.

*(Report by* L. RICHARDSON *and* W. THOMPSON.)

The Members met at the Roman Villa about 3.30 p.m.[1] In the absence of the President and the Hon. Secretary the arrangements were in the hands of Mr F. J. Cullis.

First an examination was made of the two rooms of the Villa which are accessible to the public. They were inspected with curiosity, tinged with regret at the damaged condition of the pavement, and the need which exists for a more effective preservation of the remains. This thought was expressed by Mr William Bellows, and on the motion of Mr G. M. Currie, seconded by Mr A. E. Smith, it was decided to bring the matter under the notice of the respective councils of the Cotteswold Club and the Archæological Society, with an intimation that it had been thought desirable to advise the expenditure of a certain sum of money in order to achieve the satisfactory preservation of such remains as are exposed to public investigation. It transpired that Mr W. F. Hicks-Beach, the owner of the property, had signified his readiness to co-operate with others in achieving this end, and it was also mentioned that the sites of many other Roman villas have been discovered in this neighbourhood. It has long been clear that Birdlip was an important posting station during the Roman occupation of England, and the size of the Cooper's-Hill Villa and the presence of so many others in the same picturesque district can only serve to make additionally interesting a subject which has claimed the attention of the historian and antiquarian, and which still calls for further investigation. The Cooper's-Hill Villa was discovered in 1818. Thirty-three rooms and passages were explored, but only two rooms are now exposed. The coins which have been found cover a period from the time of Constantine to that of Valens—about 100

1 For an account of a previous excursion see Proc. Cotteswold Nat. F. C., vol. viii, pt. 1 (1881-2), pp. 72-74.

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years. The bathing-establishment was complete, and contained elaborately-designed tesselated pavements[1]. (W.T.)

Leaving the villa, the Members climbed partly up the hill, where Mr Cullis read a short paper on the geology, prepared by the Hon. Secretary.

Cooper's Hill is one of the more prominent spurs of the Cotteswold Hills, running northwards into the vale and attaining an elevation of 927 feet. The highest beds belong to the Great-Oolite Series, but these as well as the subjacent Inferior-Oolite Beds are greatly disturbed. Two main faults traverse the hill. The first runs from north-west to south-east and throws the Great Oolite against the Inferior Oolite. The second runs north-by-east and south-by-west terminating at its southern end against the plane of the other fault.

The Upper Lias consists mostly of blue clay, which can be observed occasionally beneath the débris in the old quarry on the northern slope of the hill. To the west of it a steep path climbs the hill-side, and it is in the bank which has been cut into for this path that the most satisfactory section of the basement-beds of the Inferior Oolite at this locality is obtained.

The *Scissum*-Beds are seen resting directly upon the Cotteswold Sands. No Cephalopoda-Bed intervenes. It has probably been deposited but removed, as on the under surface of the *Scissum*-Beds, pebbles, rolled belemnites, and rarely fragments of ammonites (mostly of the *Phylseogrammoceras dispansum*-type) may be noticed.

Part of the upper portion of the Cotteswold Sands has also probably been denuded.

At Birdlip Hill the whole of the sand-deposit has been removed, and the *Scissum*-Beds rest directly upon the Upper Lias. This phenomenon is very well seen in an excavation which Mr A. S. Helps has made in his garden at The Knap. This artificial cave has the blue micaceous Upper-Lias clays for its walls and the massive limestones of the *Scissum*-Beds for its roof.

The *Scissum*-Beds at Cooper's Hill are 12 feet 2 inches in thickness and have yielded *Rhynchonella subdecorata*, Dav., *Rhyn.* cf. *subangulata*, Dav., *Terebratula euides*, S. Buckman, *Aulacothyris Blakei* (Walker), and several lamellibranchs.[2] Above comes typical Pea-Grit.

An old quarry where the Upper *Trigonia*-Grit was once visible, resting upon the *Buckmani*-Grit, was pointed out, and it was remarked that very fine specimens of *Terebratula crickleyensis* had once been obtained here.

It had been intended to visit some sand- and gravel-pits at Hucclecote, but time did not permit, and the Members had to be content with a glimpse of some mammalian remains—mostly teeth—which had been taken from the pits.

At the kind invitation of Mr Cullis, the Members had tea at Barnwood Court. (L.R.)

1 G. B. Witts, "Arch. Handbook County Gloucester," pp. 66, 67 Archæologia, vol. xix, p. 178. Also Proc. Cotteswold Nat. F. C., vol. v, p. 247; Trans. Bristol and Gloucester Arch. Soc., 1879-80, p. 34.

2 L. Richardson, "Handbook Geol. Cheltenham" (1904), p. 69.



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## EXCURSION TO LAVERNOCK, NEAR CARDIFF

THURSDAY, JUNE 22nd, 1905

*Director:* L. RICHARDSON

(*Report by the Director*)

The second Field Meeting was devoted to a study of the Rhætic and contiguous deposits exposed in the fine cliff-sections between Lavernock Point and St. Mary's Well Bay, Sully. The following Members were present:—The Rev Walter Butt (*President*); the Rev H. H. Winwood, F.G.S., Dr C. Callaway, F.G.S., (*Vice-Presidents*); Mr A. S. Helps (*Hon. Treasurer*); Mr L. Richardson (*Hon. Secretary*); Lieut.-Col. J. C. Duke, Dep.-Sur.-Gen. G. A. Watson, Rev J. Evans, Messrs W. Bishop, W. R. Carles, F.L.S., W. Crooke, F.A.I., G. M. Currie, O. H. Fowler, C. E. Gael, J. W. Gray, F.G.S., F. Hannam-Clark, W. H. Jordan, H. Knowles, M. Margetson, V. A. Smith, C. Upton, Col. D. O'C. Raye, and Messrs J. H. Collett and H. I. Randall came as visitors.

The party reached Lavernock Station at 12.38 p.m. and walked to Lavernock Point where they lunched. Whilst the Members were finishing their repast, Mr Richardson briefly described the geological history from the close of Coal-Measure times until the Rhætic Epoch. North of the deeply indented little bay, where the Members lunched, are seen the red marls of the Keuper, overlain by the "Tea-green and Grey Marls," these by the Rhætic Black Shales, which in turn are succeeded by the greater portion of the Upper Rhætic. Then follow the regularly-bedded limestones of the *Ostrea*- and *Planorbis*-beds. Round the Point the strata are seen to be synclinally arranged and filling in the centre of the syncline are the grey shaly clays locally called the "Lavernock Shales." Westwards older deposits rise up and the "Tea-green and Grey Marls" are seen again at St. Mary's Well Bay, Sully.

Certain portions of the upper beds of the "Grey and Tea-green Marls" are of a black colour, and the highest beds are fairly massive marlstones with very much water-worn surfaces (Plate VI., fig. 1.) Resting upon the marlstones is the very fossiliferous Bone-Bed locally called the "Fish-Bed." The equivalent of the Bone-Bed of Garden Cliff occurs about 4 feet above this "Fish-Bed." Black Shales with the usual Lower-Rhætic fossils and two massive *Pecten*-limestones complete the Lower-Rhætic Stage.

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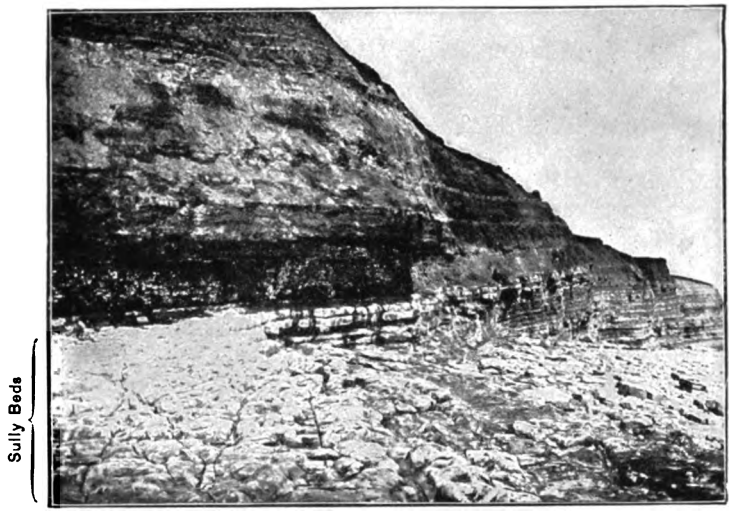


Fig. 1.—VIEW SHOWING THE UPPER SURFACE OF THE SULLY BEDS AND THE BLACK SHALES, LAVERNOCK POINT.
*(J. Storrie, Photogr.)*

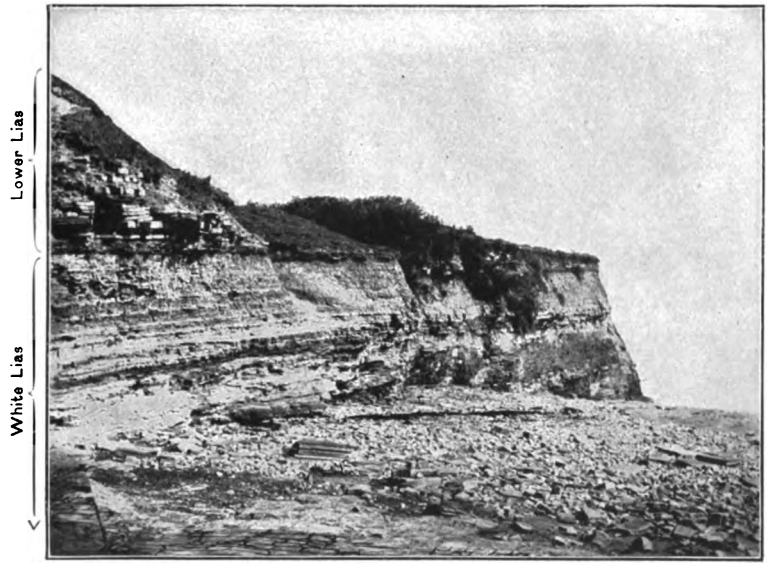


Fig. 2.—VIEW SHOWING THE WHITE LIAS AND ITS JUNCTION WITH THE LOWER LIAS AT LAVERNOCK POINT.
*(J. Storrie, Photogr.)*

(The above are reproduced by permission of the Council of the Geological Society of London.)

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Fig. 1.—THE WHITE LIAS, *OSTREA-* AND *PLANORBIS*-BEDS AT LAVERNOCK POINT, Near CARDIFF.
*(From a photograph by Prof. S. H. Reynolds.)*

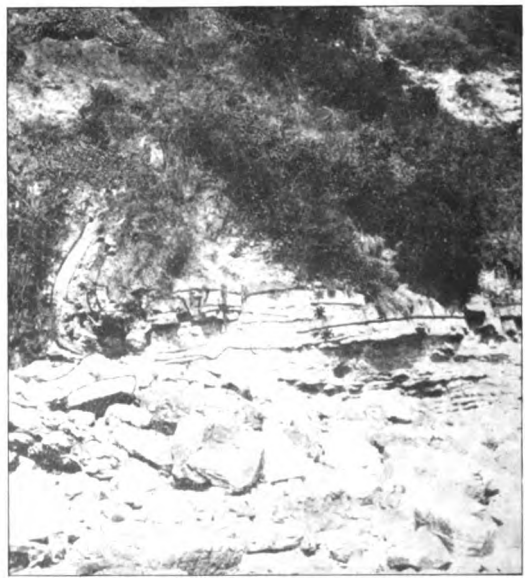

Fig. 2.—THE SULLY BEDS (✡) CONTORTED AT THE FAULT AT ST. MARY'S WELL BAY, SULLY, GLAMORGANSHIRE.
*(From a photograph by J. Storrie.)*

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Not all the component beds of the Upper Rhætic are present at Lavernock. From some cause the gritty beds of the White Lias rest directly upon a much fissured surface of those Upper Rhætic marls which are usually seen immediately beneath the *Estheria*-bed. The Members were able to examine some of these fissures, which were filled in with gritty material like that composing the bed above. The White Lias (Plate vi., fig. 2) is very poorly developed at Lavernock, but the surfaces of the thin limestone-beds are covered with fossils such as *Dimyodon intusstriata* (Emmrich), *Lima valoniensis*, Defrance, *Protocardium rhæticum* (Merian), *Plicatula Hettangiensis*, Terquem. Above all the White-Lias limestones are some marly shales similar to those seen in the Watchet District. Pale brown Paper-Shales succeed and mark the commencement of the Liassic Series. The great mass of limestones with shaly partings are most regularly-bedded, and well-exposed in the Point (Plate vii., fig. 1).

The third limestone above the Paper-Shales commences a series of four limestone-beds locally known as the "Washers," which are extremely persistent in this part of Glamorganshire. The great mass of grey shale known as the "Lavernock Shales" belongs to the *Angulata*-Zone and contains *Cardinia ovalis* (Stutchbury), a fosssil common in the equivalent beds at Down Hatherley, near Cheltenham. Inaccessible, at the top of the section, are seen the limestones of the *Bucklandi*-Zone.

Numerous fossils were observed by the Members on the surfaces of the limestone-beds which successively cropped out in the shore. Thus older and older strata appeared, and the Rhætic was again seen at St. Mary's Well Bay.

The section here is very important. The top-beds of the "Tea-green and Grey Marls" are extremely fossiliferous. By the Geological Survey the line between the Rhætic and Keuper is drawn at the top of these fossiliferous marls, but the palæontological evidence before the Members showed that without doubt the division-line must be drawn lower down, and at the base of these fossiliferous strata, or Sully Beds.[1] (Plate VII., fig. 2).

A very interesting fault was studied here, and the Sully Beds were seen bent round against the "Dolomitic Conglomerate" (Plate VII., fig. 2).

After a more detailed investigation of the "Dolomitic Conglomerate," the Members had tea at Swanbridge Farm, and returned to Dinas Powis Station.

Col. D. O'C. Raye was elected a Member.

1 L. Richardson, Quart. Journ. Geol. Sec., vol. lxi. (1905), pp. 386, 387, 394, 395, 410-414.

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## HALF-DAY EXCURSION TO LECKHAMPTON HILL, CHELTENHAM

SATURDAY, JULY 8th, 1905.

*Director:* L. RICHARDSON

*(Report by the Director.)*

The following Members assembled at the tram-terminus: Mr A. S. Helps *(Hon. Treasurer)*, Mr L. Richardson *(Hon. Secretary)*, Lieut.-Col. J. C. Duke, Dr W. Washbourn, and Messrs H. Bubb, J. M. Collett, C. E. Gael, J. W. Gray, F.G.S., J. N. Hobbs, J. W. Skinner, V. A. Smith, and W. Thompson. Mr J. A. Coombs, F.G.S. came as a guest.

Having arrived in the large quarry (fig. 1) the Director gave an outline of the geology of the immediate neighbourhood.

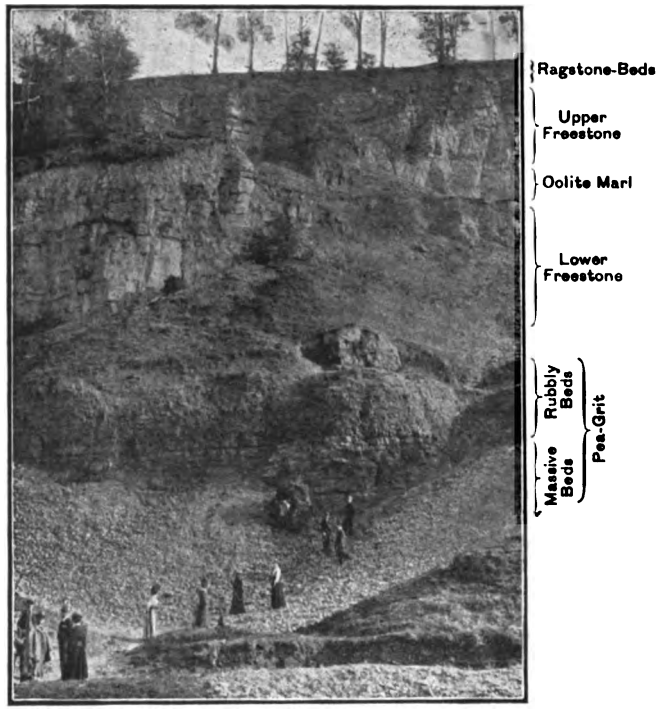


Fig. 1.—LECKHAMPTON HILL QUARRY.*
*(Prof. S. H. Reynolds, Photogr.)*

* Reproduced from "A Handbook to the Geology of Cheltenham" (1904), pl. vii.

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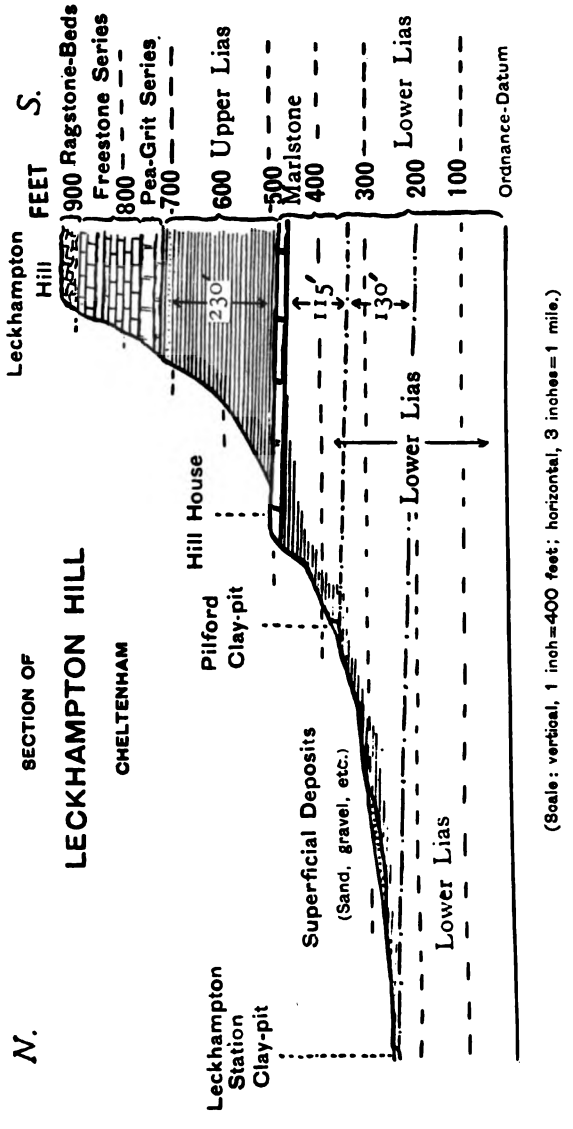
The clay-pit at Cheltenham South and Leckhampton Station is in the *Valdani*-Beds, and that at Pilford (or as it is locally called "Pilley") in the *Capricornus*- and (presumably) *Algoviani*-Beds. The




rock-bed of the Middle Lias creates a noticeable feature and forms the tabulated promontory upon which Hill House is built (*vide* section).

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The Upper Lias is about 230 feet thick, and from recorded observations appears to be an almost wholly argillaceous deposit. In the bank by the road-side near the house called "Firs Brake," Upper-Lias clays, becoming somewhat sandy, are seen with tumbled Inferior-Oolite rock above, and near "Daisy Bank" still more arenaceous Upper Lias is visible in an excavation fast becoming overgrown. The latter exposure orginated in an excavation made, so Mr J. W. Gray was informed, in order to obtain sand for mixing with the clay dug at the Leckhampton-Road (near the station) brick-works. How thick this sand-deposit is the Director has never been able to ascertain.

About the year 1850, the actual junction of the Liassic and Inferior-Oolite Series seems to have been visible, and the details of the section were recorded by the Rev. P. B. Brodie. As the volume of the Quarterly Journal of the Geological Society[1] containing this paper is an early one and therefore not readily obtainable, it has been deemed desirable to reproduce Brodie's remarks (section, page 189).

It will be observed that Brodie does not mention any conspicious sand-deposit at the top of the Upper-Lias clays. Immediately beneath the Belemnite-Bed (41 in section on page 189), he records a 3-inch deposit of a "brick-coloured and dark yellow sandy marl." Recently Mr J. W. Gray told the Director that when a path was being constructed in the grounds of "Firs Brake" a deep-red sandy marl, which had been excavated, attracted his attention. No doubt it was a continuation of this same bed.

Although Brodie has not recorded a sand-deposit of any thickness, there is doubtless an arenaceous deposit present. It may be suggested that the sequence about the junction of the two series, the Liassic and Inferior-Oolite, is similar to that at Crickley Hill,[2] where in descending order we have the the *Scissum*-Beds; micaceous, greyish-blue clay (1 to 2 feet); sand, yellowish indurated and very micaceous with some ferruginous nodules (4 to 6 feet); and blue clay from which water is thrown off. Thus, if only the actual junction of the two series were exposed to view, it would seem as if no sand deposit were present, whereas it really occurs beneath a clay capping.

The Inferior-Oolite rocks between the Upper Lias and the *Clypeus*-Grit measure about 200 feet, or between the Upper Lias and Upper *Trigonia*-Grit about 194 feet. In the district between Bath and Frome the Upper *Trigonia*-Grit, represented usually by a more or less conglomeratic deposit, rests generally directly upon the Upper Lias, and in the hill-country east of the Rissingtons, near Burford, the *Clypeus*-Grit rests directly upon the Upper-Lias clays. In the North Cotteswolds the rocks between the Upper Lias and the *Clypeus*-Grit attain a much greater thickness than at Leckhampton Hill.

Bed 41 of the section, given on page 189, the lowest hard bed of the Inferior-Oolite Series, Brodie considered worthy of the denomination "bone-bed." "The bones, scales, coprolites, and teeth are very

1 Vol. vii (1851), pp. 208-212.

2 This succession was noticed along the escarpment to the south of the Green Way.

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minute, rolled, and fragmentary, but in sufficient numbers to form a kind of *Bone*-bed, and probably belong to more than one species of Fish, and I have only noticed one which could be ascribed to Saurians. Teeth are not common; the few which have been discovered were pronounced by Sir P. Egerton to belong to a species of *Hybodus*." Some fragments of the bones, etc., were submitted by Brodie to a Mr J. C. Nesbitt for analysis, and found to contain "between 40 to 50 per cent. of phosphate of lime." The basement-bed of the *Scissum*-Beds on the south face of Crickley Hill is largely composed of shell-débris, but contains also a few well-preserved specimens of *Aulacothyris Blakei* and *Rhynchonella cynocephala*, and numerous black particles. Dr E. W. Skeats, F.G.S., now Professor of Geology in the University of Melbourne, kindly furnished the Director with the following megascopic description of a hand-specimen. "The rock consists of a fairly compact limestone, of a greenish-brown colour. It contains a large amount of finely divided calcareous mud in which occur numerous angular pieces of shells, cleavage-fragments of sea-urchin spines and a large number of small brown and black shining grains. These have a vitreous lustre, sometimes exhibit a conchoidal fracture, while a chemical examination shows that phosphorus is present in abundance." These black particles are no doubt the fragments of bone, etc., noticed by Brodie.

The Director then described the Pea-Grit, the lower beds of which at Cleeve Hill furnish good blocks for foundation-stones. Reference was made to Mr E. B. Wethered's very interesting discoveries with regard to the origin of the pisolite-spherules. Mr Wethered had found out that some, indeed most, of the spherules were formed by the growth of minute tubular bodies, possibly thallophytes, around a nucleus. Others however were no doubt concretionary, layer after layer of calcareous material having accumlated around the nucleus.

Above the Pea-Grit, and between it and the Ragstones, come the series of freestone-beds with the intervening Oolite Marl to which Lycett applied the term "Fimbria Stage." He remarked that the freestones were "for the most part a Gloucestershire group of beds or subformation, which rapidly diminishes in its extension both to the north-east and south-west, beyond the limits of the county," and that the section at Leckhampton Hill was "the most comprehensive example afforded by any one section of the freestone."[1] These remarks of Lycett are certainly correct.

The "Fimbria Stage" admits of division into three parts—the Lower Freestone, Oolite Marl, and Upper Freestone. The thickness of the first-named seems generally to have been over estimated. Mr Paris and the Director have measured it on two occasions with the same result and find it to be 77 feet 9 inches. At about 40 feet above the base of the Lower Freestone there is an interesting deposit 3 feet 9 inches in thickness which in one place consists of imperfectly-bedded

1 "The Cotteswold Hills" (1857), p. 35.

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shelly limestones, with less compact partings; in another false-bedded oolite; whilst in the new quarry in the direction of the Devil's Chimney it is represented by a very conspicuous band of clay.

In the early days of Inferior-Oolite geology the Lower Freestone was divided into two parts—the Lower Ragstone or Roestone and what Murchison called *The* Freestone because it was the best building-stone and was the most extensively quarried. The thickness of this Freestone, Strickland found to be 31 feet 6 inches—nearly the same as that in the present record. But the "Roestones" (a coarser limestone than the Freestone, more variable in texture, and less extensively quarried) he estimated at 75 feet. This, however, is certainly an over-estimate.

Strickland and Brodie probably worked in company, because in the same year as the former geologist's remarks were published, Brodie communicated a paper dealing more particularly with the fossils from the "Roestone," or as he termed it the "shelly freestone," and also from a bed of coarse crystalline limestone, "mainly composed of shells and corals a foot and a half thick," which occurs at 18 feet below the Oolite Marl. From these strata Brodie obtained an astonishing number of small fossils. Those fossils for which there were names in existence were listed in the Quarterly Journal of the Geological Society for 1850,[1] whilst the new forms were described by Lycett.[2] These researches revealed the interesting fact that in addition to the strata presenting great similarities in lithological characters with some of the Great-Oolite Beds, they contained many forms of life not unlike those of the date of the later strata.

The Oolite Marl was pointed out and it was remarked that at Leckhampton Hill it was more "rocky" than at most places. On the adjoining Charlton Common (as the Members saw later in the afternoon) it was much softer. In the new quarry near the Devil's Chimney, the Oolite Marl is very well seen with the greater part of the Upper Freestone above. Here again it is fairly compact and barely 8 feet in thickness. The "Marl" merges somewhat into the overlying freestone, and after the beds have been weathered for some time it is difficult to say definitely where the one division ends and the other begins. This accounts for the thickness assigned to the Oolite Marl by various authors varying from 6 to 17 feet. The Oolite Marl is very fossiliferous, *Terebratula fimbria* being the most abundant fossil. Details of the Upper Freestone will be found in the section.

The position of the fault depicted in Plate VIII was indicated, and it was mentioned that this was a very convenient place for examining the Oolite Marl, Upper Freestone, Lower *Trigonia*-Grit and the basal portion of the *Buckmani*-Grit.

In the early days of Inferior-Oolite geology the series at Leckhampton Hill above "the flaggy light-coloured oolitic beds" (the Upper Freestone) consisted of Gryphite-Grit and *Trigonia*-Grit. H.

1 Vol. vi., pp. 247-249.
2 Ann. Nat. Hist., vol. vi., No. 36 (Dec., 1850).

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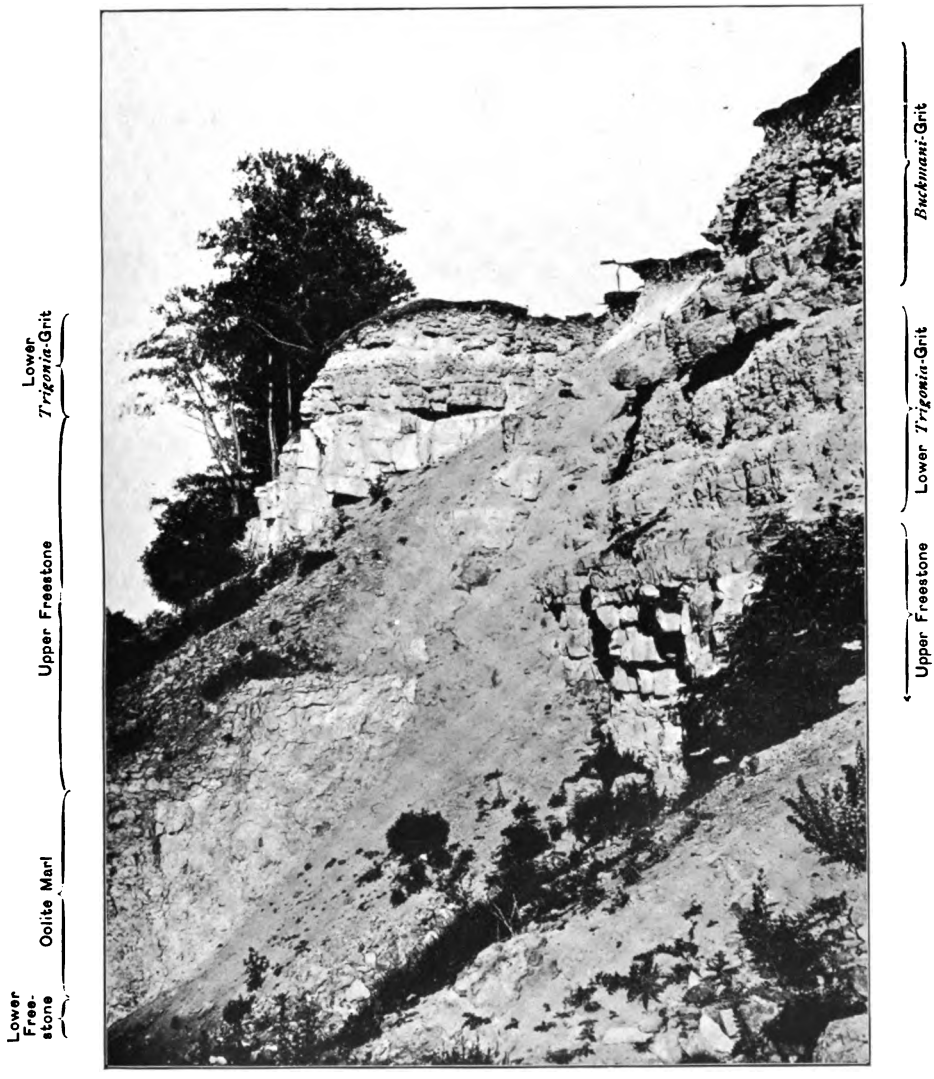


VIEW OF THE FAULT AT LECKHAMPTON HILL

*(J. W. Gray, Photogr.)*

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E. Strickland, however, in 1850 examined the section and found that besides the several recognised divisions being much greater than was thought they admitted of further division. Between the "oolitic freestone," that was "too fragmentary to be of much value for building," and the Gryphite-Grit proper he noticed very fossilferous "beds of brown rubbly Oolite, not employed for any purpose" and 24 feet thick. These intervening beds are now known as the Lower *Trigonia*-Grit and *Buckmani*-Grit. The *Buckmani*-Grit beds between the sand-deposit (13) and the Lower *Trigonia*-Grit are thicker than has been hitherto supposed—5 feet 7 inches as against about 3 feet.

The Gryphite-Grit was seen in a disused quarry on the hill-top by the side of the tram-line not far from the windlass. Farther south (on the hill-top) the junction of the Notgrove Freestone and Upper *Trigonia*-Grit was examined, and particular attention was paid to the top-bed of the former, which is remarkably well bored by annelids and less commonly by *Lithophagi*. Oysters were observed strewn over the planed surface. It was mentioned that a considerable thickness of beds was missing from between the freestone and the grit, but that some of them came in farther to the north on the Cleeve-Hill plateau. In order to show that there was no doubt that additional beds came in at certain horizons in the Inferior-Oolite Series, a visit was paid to Charlton Common, where between the Lower *Trigonia*-Grit and the Upper Freestone was seen clay—the Upper Snowshill Clay.

An outline of the theory of River Development, which found so able an exponent in the Club's former Hon. Secretary, Mr S. S. Buckman, was given by the Director and after some discussion the afternoon's proceedings terminated.

## SEQUENCE OF STRATA AT LECKHAMPTON HILL, CHELTENHAM.

| | | *Thickness in* Feet | inches |
|---|---|---|---|
| [*CLYPEUS*-GRIT | Denuded from off the top of the hill]. | | |
| UPPER *TRIGONIA*-GRIT | 1. Hard shelly limestone. The lower bed some 10 inches thick is called by the workmen the "Middle Bed." *Terebratula globata*, Sow., *Rhynchonella subtetrahedra*, Dav. *Rhyn. hampenensis*, S. Buckman, *Zeilleria Hughesi* (Walker), *Pteria digitata* (Desh.), etc., seen 5 feet, add 1 foot | 6 | 0 |
| NOTGROVE FREESTONE (2 feet 10 inches) | 2. The "Bored-Bed." Grey oolitic limestone, very much bored by annelids and *Lithophagi*, and covered with oysters | 0 | 7 |
| | 3. Grey oolitic limestone; *Sonninia* (poor casts) | 1 | 2 |
| | 4. The "Dirt-Bed." Earthy parting | 0 | 4 |
| | 5. The "Sandy-Bed." Oolitic limestone with numerous broken shells | 0 | 9 |
| *(See over)* | 6. The "Bottom-Bed." Ragstone with *Gryphæa "sublobata"* (Deshayes). This bed is in two seams with an earthy parting. It was in this parting, according to the quarrymen, that several ammonites of the *Sonninia fissilobata*-type occurred | 1 | 1 |

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| | | Thickness in Feet | inches |
|---|---|---|---|
| GRYPHITE-GRIT (4 feet 11 inches) | 7. Earthy parting; ammonites occasionally | 0 | 2 |
| | 8. The "Rockery-Bed." Ragstone with numerous specimens of *Gryphæa* "*sublobata*" | 0 | 5 |
| | 9. Earthy parting with *Gryphæa, Sonniniæ* of the *S. fossilobata*-type *in situ* | 0 | 3 |
| | 10. "Beds below the Rockery." Two beds with *G.* "*sublobata*" abundant | 2 | 3 |
| *BUCKMANI*-GRIT (16 feet) | 11. Shelly ragstone with *Trigoniæ*, bored for some inches at the top | 0 | 9 |
| | 12. Yellow sandy limestone with sandy partings; *Gryphæa* "*sublobata*" (Desh.), *Terebratula Buckmani*, Dav., *Ter. Uptoni*, S. Buckman: about | 10 | 0 |
| | 13. Bright yellow sands | 0 | 5 |
| | 14. Sandy limestone | 0 | 5 |
| | 15. Brown and dark-coloured sandy marl; *Terebratula Buckmani*, Dav., *Ter. cricklayensis*, S. Buckman, *Acanthothyris*, spp. nov. | 0 | 9 |
| | 16. Greyish limestone; *Ter. Buckmani* (rare): 4 inches to 6 inches | 0 | 5 |
| | 17. Brown and dark-coloured clayey marl; *Terebratula Buckmani* | 0 | 4 |
| | 18. Limestone, *Terebratula Buckmani* (at the top) *Galeolaria socialis* | 1 | 11 |
| | 19. Marl | 0 | 2 |
| | 20. Limestone, *Ctenostreon pectiniforme* (Schloth.) common, *Terebratula Uptoni* | 0 | 8 |
| | 21. Brown marl with streaks of black clay | 0 | 4 |
| | 22. Limestone, hard, yellow, sandy; *Pecten* (*Syncyclonema*) *demissus*, Phillips, *Galeolaria socialis*, Goldfuss, *Serpula* spp. | 0 | 7 |
| LOWER *TRIGONIA*-GRIT (7 feet 4 inches) | 23. Yellowish-brow and grey, ironshot, rubbly limestone, conglomeratic near the base. *Aulacothyris-Meriani* horizon 2 feet above the top of the Upper Freestone. *Terebratula degenerata*, Upton, *Modiola Sowerbyana*, *Gryphæa*, *Pholadomya ovulum*, Ag. | 7 | 0 |
| | 24. Earthy layers with rolled pieces of rock | 0 | 4 |
| | 25 Massive-bedded oolite | 10 | 0 |
| UPPER FREESTONE (32 feet 9 inches) | 26. Brown and pinkish-tinged marly deposit 1 inch to 7 inches | 0 | 4 |
| | 27. Whitish limestone with yellowish oolite-granules; corals frequently found at the base, *Pholadomya* | 2 | 2 |
| | 28. Rubbly deposit, pisolitic in places; 6 inches to 10 inches | 0 | 8 |
| | 28. Limestone, not conspicuously oolitic | 1 | 1 |
| | 28. Yellow earthy deposit; *Pentacrinus* | 0 | 2 |
| | 29. Limestone, massive, oolitic, *Rhynchonella Witchelli*, Richardson and Upton, MS., *Terebratula fimbria*, Sow. | 5 | 2 |
| | 30. Limestone, fairly conspicuous: 8 inches to 12 inches | 0 | 10 |
| | 31. Limestones, massive, oolitic; *Trigonia*, *Trichites* | 9 | 0 |
| | 32. Softer and more oolitic limestone | 3 | 4 |

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| | | *Thickness in* *Feet* | *inches* |
|---|---|---|---|
| OOLITE MARL (10 feet) | 33. Whitish, chalky-looking rock, here more indurated than usual; *Terebratula fimbria*, Sow.; 8 feet to 10 feet | 10 | 0 |
| LOWER FREESTONE (77 feet 9 inches) | 34. Massive yellowish limestones: about Noticeable rubbly deposit which can be seen passing laterally into a markedly false-bedded oolite. This deposit in its rubbly condition consists of two or three bands of rubbly limestone with intervening brown clay-streaked oolitic marl with pebbles in places | 34 | 0 |
| | 35. Massive yellowish limestone, oolitic, false-bedded, and the whole very much bored: about | 3 | 9 |
| PEA-GRIT (32 feet) | 36. Brownish-yellow, rubbly, coarsely pisolitic rock with more compact bands of grey pisolitic limestone. Usual fossils | 40 | 0 |
| | 37. Massive-bedded, grey pisolitic limestones the upper strata being called the "Weather-stones." Usual fossils | 12 | 0 |
| LOWER LIMESTONE (6 feet) | 38. Brown and grey limestones: about | 20 | 0 |
| *SCISSUM*-BEDS (4 feet 4½ inches) | 39. Ferruginous oolite "made up of small brown, oval, shining grains like small seeds, cemented together by a sort of calcareous paste of a yellow and brown colour." *Belemnites* and *Ostreæ* | 6 | 0 |
| | 40. "Yellow sand without fossils" | 3 | 0 |
| | 41. "Hard dark grey, approaching to brown, shelly, crystalline limestone, containing *Belemnites*, some *Ammonites*, *Pectines* (*P. lens*), *Terebratulæ* (especially *T. bidens*) [= *Rhyn. cynocephala*], *Lima*, *Amphidesma*, *Gervillia*, and *Serpulæ*. Bones, scales, Coprolites and Teeth of Fish are dispersed throughout the mass, and may be most readily distinguished on the surface, intermixed with the same brown oval grains as in D [i.e. bed 39] higher up. The Limestone has been bored into by *Lithodomi*, and the cavaties are often filled up with fragments of bones, etc. At its junction with the sand above [bed 40] it is of a yellow colour, and it passes in a yellow ferruginous, pure, sandy, micaceous stone, with fewer oval particles, full of *Belemnites*, *Ammonites*, *Pectines*, and numerous fragments of Bones, Scales and Coprolites. On the whole, *Belemnites*, are more abundant than *Ammonites* at Leckhampton | 0 | 0 |
| | 42. "Brick-coloured and dark yellow sandy marl, with broken Shells, chiefly Pectins, and small spines of *Cidaris*" | 1 | 0 |
| UPPER LIAS | "Blue micaceous shale": about | 0 | 3 |
| MIDDLE LIAS | Marlstone | 230 | 0 |

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## EXCURSION TO WICKWAR AND HAWKESBURY

TUESDAY, JULY 25th, 1905

*Directors:* REV H. H. WINWOOD, M.A., F.G.S., and L. RICHARDSON

(*Report by* L. RICHARDSON)

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The Members who attended the third Meeting, in addition to the *Directors*, were the Rev Walter Butt (*President*), Mr A. S. Helps (*Hon. Treasurer*), Messrs W. Crooke, F.A.I., G. M. Currie, T. S. Ellis, C. E. Gael, F. Hannam-Clark, J. N. Hobbs, W. Margetson, J. W. Skinner, A. Slater, W. J. Stanton, W. Thompson, Surgeon-Major I. Newton, and the following visitors attended: Messrs Chatfield, W. May, S. J. Coley, A. E. Zealey, and C. J. Watkins, F.E.S.

Arrived at Wickwar, the Members walked over the rising ground to the west of the Station, Mr Winwood pointing out on the way an exposure of Old Red Sandstone. In the large quarry by the side of the Charfield road, where the Carboniferous Limestone is extensively worked, with a map spread out on the rocks in front of the Members, Mr Winwood gave an outline of the geology of the northern portion of the Bristol Coalfield. They had crossed, he said, in their walk from the Station, the Old Red Sandstone and Lower Limestone Shales, and now stood in a quarry in the *Zaphrentis*-Zone of the Carboniferous Limestone. All these rocks dipped approximately westwards under the Millstone-Grit and Coal-Measures, to appear again in the ridge by Tytherington. He recommended those who desired fuller information to read Dr A. Vaughan's masterly and original paper on "The Palæontological Sequence in the Carboniferous Limestone of the Bristol Area."[1]

Mr Watkins discovered the eggs of *Tetranychus lapidum* securely attached to the limestone in this quarry. Like the red spiders and the harvest-bug, the young of the earth-mite possess only six legs, while the parents are furnished with eight—the character of the perfect state of all mites. In comparison with the movements of other animals, these tiny creatures can command a speed of locomotion probably the swiftest known.

Passing through Wickwar, other sections of the Old Red Sandstone were noticed. At the bridge over the Little Avon, Mr Richardson continued the outline of the geology of the district commenced by Mr Winwood. The rocks exposed in the brook belong to the Keuper Series—the oldest division of the Neozoic Group present in the

1 Quart. Journ. Geol. Soc., vol. lxi. (1905), pp. 181-307, and pls. xxii-xxix.

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district. During a considerable part of the Keuper Epoch an inland sea extended over the greater part of England, but rising from amid the waters in the Bristol area were a number of islands. Between Chipping Sodbury and Bitton were one or two, but north of the latter place a continuous ridge, which curved round westwards to the south of Tortworth, expanded in a south-westerly direction to the south of Thornbury, and ended in a much indented coast-line by Olveston. Wrapping round these ancient shore-lines and running up many of the creeks, was an extensive beach-deposit—the now well-known "Dolomitic Conglomerate." Such a deposit was visible by the brook-side, but mention was made of a far more instructive section on the western slope of the ridge at Bury Hill, some two miles south of Wickwar (fig. 1), where the "Dolomitic Conglomerate" (C and B) is to be seen overlying the Carboniferous Limestone. The surface deposit (A) is sandy, and contains occasionally pieces of sandstone which may be of Rhætic Age.

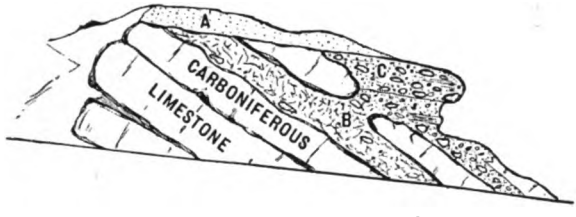


FIG. 1.—SECTION AT BURY HILL SHOWING THE LITTORAL KEUPER RESTING UPON THE CARBONIFEROUS LIMESTONE.

Ascending Chase-Hill Lane, the Red and "Tea-green" Keuper Marls were examined, and indications of a very fossiliferous development of the Rhætic Bone-Bed were observed.[1]

Mr Richardson here remarked that the valley the Members were leaving had been entirely excavated by the stream. Once the Rhætic Beds were continuous westwards, overstepping on to the Palæozoic Rocks. They did not extend across the ridge, as is shown farther to the south by the Rhætic being overstepped by the Lower Lias, which at Wickwar and Yate Commons rests directly upon the Carboniferous Limestone.

At the head of the little valley, and after the breaks[2] had passed through the gate on to the extensive Inglestone Common, Mr Richardson pointed out the place in the bed of the brook at the back of the

1 Geol. Mag., dec. 5, vol. i., pp. 532-535.

2 It may be of interest to record why this word is thus spelt, and not "brake." In a letter (June 20th, 1899) to Mr S. S. Buckman, when Secretary of the Club, the late H. G. Madan wrote "May I suggest that 'break' is the correct way of spelling the name of the conveyance in which we take our drives. It is simply a 'carriage body' put on the backbone of the machine used for 'breaking in' horses, and has nothing to do with the brake of a train."

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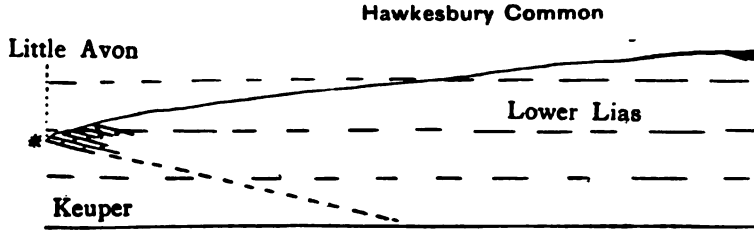
cottage where he had found Cotham Marble—the northernmost locality, he believed, at which typical Cotham Marble had been noticed. Parted by a very thin shale-deposit were the *Ostrea*-beds of the Lower

Fig 2.—SECTION ACROSS THE ESCA




* Rhætic † Marlstone (Scales: vertical, 1 inch=400

Lias. There is no White Lias intervening. In this neighbourhood the Rhætic Series is about 20 feet thick.

The clay-flats of Inglestone Common presented little of interest. The broken ground by the roadside at the commencement of the Common indicated old workings in the limestones such as occur throughout Gloucestershire at the base of the Liassic Series.

Hawkesbury Church was visited, and in the absence of the Vicar, who unfortunately did not arrive until the Members were leaving, Mr Hannam-Clark made some remarks upon the edifice.

The Church was restored some twenty years ago, but happily without depriving it of the numerous features of antiquarian interest. On the south side is a Norman doorway supported by Saxon bases. In the chancel is a matrix of what must once have a very fine brass. It belonged to a Benedictine Abbot, and it may be mentioned that as far back as the seventh century a religious house stood on the site of the Church. It was from Hawkesbury that Earl Liverpool, the statesman who served George III., took his title—a title which has been recently revived.

Hawkesbury Church is built upon the Marlstone (see fig. 2). Above come Upper-Lias clays, apparently about 12 feet thick, the top of which is indicated (especially in wet weather) by the outburst of a spring in the road-side. The Cotteswold Sands which succeed, are about 180 feet thick, and are capped with the *Cephalopoda*-bed. The strata identified with the *Scissum*-Beds are scarcely typical and contain

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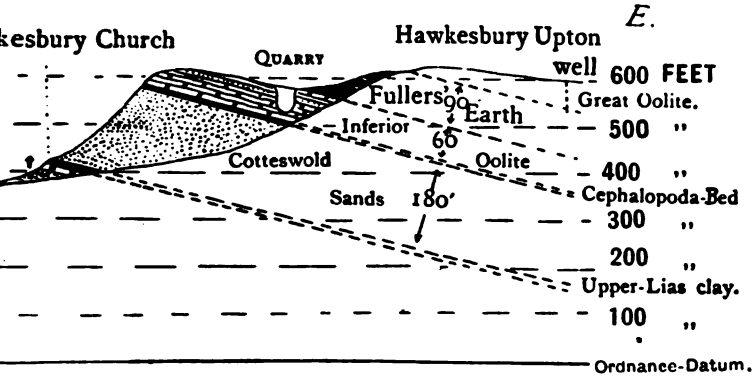
few fossils. These strata, with the greater portion of the *Cephalopoda*-bed, are visible in an opening by the road-side. Then there is a gap followed by the section in the large quarry.

ENT OF THE SOUTH COTTESWOLDS.




; horizontal, 3 inches = 1 mile.)

## HAWKESBURY QUARRY

| | | *Thickness in* Feet | inches |
|---|---|---|---|
| FULLERS' EARTH. | 1. Grey and yellow clay with some argillaceous limestone-beds full of *Ostrea acuminata*, Sowerby | | |
| "WHITE LIMESTONE." | 2. Limestone, white, oolitic: about | 10 | 4 |
| "*CLYPEUS*-GRIT." | 3. Limestone, rubbly in places | 9 | 6 |
| UPPER *TRIGONIA*-GRIT | 4. Ragstone, very shelly and slightly iron-shot, *Ctenostreon pectiniforme* (Schlotheim), *Trichites* (fragments), *Trigonia costata*, Sowerby, *Pteria digitata* (Deslongchamps), *Pleurotomaria*, *Rhynchonella hampenensis*, S. Buckman, *Acanthothyris spinosa* (Schlotheim) | 4 | 10 |
| LOWER LIMESTONE | 5. Limestone, massive, oolitic. Top water-worn, bored, and oyster-strewn; *Pecten* (*Amusium*) *personatus*, Goldfuss | 8 | 8 |
| | 6. Two or three beds of similar limestone | 5 | 2 |
| | 7. Parting, very conspicuous | 0 | 1 |
| | 8. Massive bed of oolitic limestone | 4 | 4 |
| | 9. Similiar massive bed: seen | 2 | 1 |
| | [Gap: probably similar strata, for say | 6 | 10] |
| *SCISSUM*-BEDS | 10. About seven beds of oolitic, but not very massive-bedded strata | 5 | 0 |
| | 11. Brownish-red clay and rubble | 0 | 5 |
| | 12. Limestone, grey, arenaceous | 0 | 10 |
| | 13. Brownish-red clay and limestone | 0 | 8 |
| | 14. Grey sandy slightly iron-shot limestone | 0 | 5 |

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| | | Thickness in Feet | inches |
|---|---|---|---|
| *Opaliniforme*-Bed | 15. Pale-brown, somewhat sandy limestone; *Montlivaltia, Modiola Sowerbyana*, d'Orb. | 1 | 4 |
| | 16. Rubbly parting: *Terebratula* aff. *haresfieldensis*, Davidson, 0" to 2" | 0 | 1 |
| | 17. Limestone, iron-shot, very shelly. 9" to 13" | 0 | 11 |
| | 18. Rubbly iron-shot limestone and marl | 0 | 6 |
| | 19. Limestone, brown, compact, crystalline, usually devoid of recognisable limonite-granules except at the top; *Pecten* | 1 | 0 |
| | 20. Limestone, light brown, iron-shot, earthy; is joined on to the bed above | 0 | 9 |
| Cephalopoda-Bed | 21. Brownish-red clay: ¼" to 3" | 0 | 2 |
| | 22. Pale-brown marl with dark limonite-granules, indurated at the top but softer at the base; *Rhynchonella cynocephala* (Richard), *Terebratula haresfieldensis*, Davidson, *Aulacothyris* aff. *Blakei* (Walker), *Zeilleria*, sp. nov., *Belemnites*, spp., *Ammonites (Phylloceratoceras) subundulata* | 1 | 9 |
| | 23. Two beds of pale-brown iron-shot limestone *Pecten (Syncyclonema)* sp. seen | 2 | 0 |
| | [24. Unexposed; say | 2 | 10 |
| Upper Lias | 25. Cotteswold sands; estimated at | 180 | 0 |
| | 26. Upper-Lias clay; about | 12 | 0 |
| Middle Lias | 27. Marlstone | | ] |

At this locality the thickness of the deposit separating the Fullers' Earth from the Marlstone is about 262 feet 6 inches; the Inferior Oolite measuring about 60 feet.

Instructive as the section in the large quarry is, it has received but little attention. Holl mentioned it as being much the same as that at Horton, and thought that the freestone was probably about 25 feet in thickness[1]; but Mr H. B. Woodward left it unnoticed in his survey of "The Lower Oolitic Rocks of England (Yorkshire excepted)."[2]

Higher up the hill a spring by the road-side indicates the presence of the Fullers' Earth Clay, which is also to be seen in the sides of a pond in the field immediately to the north of the spring and also in the bank bordering the road. In the latter exposure *Ostrea acuminata* is very common. The Fullers' Earth is close upon 90 feet thick, and extends as far as the rise in the road near the Police-Station, which is caused by the presence of the basement-limestones of the Great Oolite.

Hawkesbury Upton derives its water supply from the Fullers' Earth, which is reached by means of wells sunk through the Great Oolite. A well (see fig. 2) near the Baptist Chapel is 60 feet deep. The basal portion of the Great Oolite in this neighbourhood does not yield "slates" fit for roofing purposes; the stone-tiles seen in the village have been brought from a distance.

Time did not permit of a visit to the quarry below the Monument, but the gentle declivity formed by the Fullers' Earth, and the slope (rising towards the escarpment) which is caused by the inclined Inferior-Oolite strata, were pointed out.

1 Quart. Journ. Geol. Soc., vol. xix. (1863), p. 310.
2 Mem. Geol. Surv., "Jurassic Rocks of Britain," vol. iv. (1894).

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Indications of the Fullers' Earth abound. The clay is seen by the road-side nearly as far down as the 600-foot contour-line, when white oolitic limestones are to be observed beneath it. This limestone has been worked in a long-disused quarry on the knoll above Knott's Brake, and caps the section in the present quarry by the road.

| | HAWKESBURY-MONUMENT QUARRY | *Thickness in* Feet | inches |
|---|---|---|---|
| FULLERS' EARTH | 1. Clay, greenish-grey. Has filled-in cracks in the White Limestone | | |
| "WHITE LIMESTONE" | 2. Limestone, white, oolitic, seen in quarry about 6′: add 4′ | 10 | 0 |
| | 3. Fairly regular deposit of rubble and calcite | 0 | 1 |
| "*CLYPEUS*-GRIT" | 4. Massive bed of hard shelly limestone with large oolite-granules; *Terebratula globata*, Sowerby, *Pecten (Syncyclonema) demissus*, Phillips, *Pecten (Camptonectes)* sp. | 3 | 0 |
| | 5. Parting | 0 | 1 |
| | 6. Limestone, hard, shelly, with an even top but irregular base: 15″ to 17″ | 1 | 4 |
| | 7. Rubbly limestone, mixed with brown shale | 0 | 6 |
| | 8. Obscurely oolite limestone, irregularly bedded with alternations of shale | 4 | 4 |
| | 9. Shaly, very much iron-shot limestone | 2 | 2 |
| UPPER *TRIGONIA*-GRIT | 10. Brown, well iron-shot, dense limestone; *Ctenostreon pectiniforme* (Schlotheim), *Limatula* aff. *gibbosa* (Sowerby), *Lima Lycetti*, Laube, *Ostrea*, *Terebratula globata*, Sow., *Ter.* cf. *globata*, Sow., *Acanthothyris spinosa* (Schlotheim), *Pentacrinus*-ossicles, *Galeolaria socialis*, Goldfuss, *Serpula*, *Berenicea*, sp. indet. | 4 | 6 |
| LOWER LIMESTONE | 11. Limestone, hard, coarsely-oolitic, top well-planed, bored, and oyster-covered: seen | 3 | 0 |

Bed 9 is only provisionally grouped with the so-called *Clypeus*-Grit. Its lithic structure connects it with the Upper *Trigonia*-Grit, but at the several localities where it has been noticed it has been observed to rest upon an oyster-covered and often bored surface of the underlying beds. From the equivalent stratum near Nailsworth, has been obtained *Terebratula subsphæroidalis*, Upton. At a lower level than the quarry, in the hill-side to the north of the road, the *Dumortieria*- and *Moorei*-Beds are exposed and below them in another opening the Cotteswold Sands.

Lunch was taken in *al fresco* fashion in the grounds of the Monument, after which Mr J. N. Hobbs, of Cheltenham, was elected a Member and Messrs S. J. Coley and J. G. Wenden were proposed. The President then drew attention to the desirability of preparing a Flora for Gloucestershire (see page 172).

Some of the Members ascended the Monument and obtained a magnificent view over the surrounding country.

The drive was then continued to Kilcott, where at their pleasantly situated bungalow, Mr Hannam-Clark and his daughter very kindly entertained the Members at tea, after which they drove to Charfield Station.

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## EXCURSION TO HEREFORD

TUESDAY, SEPTEMBER 5TH, 1905

*Directors:* REV. H. E. GRINDLEY, M.A., and H. C. MOORE

(*Report by:* W. THOMPSON.)

Commencing with a Cathedral city (Bath) in the Spring, the Members brought the Summer season of 1905 to a close with an excursion to Hereford, which of course is happy in the possession of a Cathedral of very considerable interest. Those present were Rev. Walter Butt *(President)*, Rev. H. H. Winwood, F.G.S. *(Vice-President)*, Mr A. S. Helps *(Hon. Treasurer)*, Mr F. J. Cullis, F.G.S. *(Hon. Librarian)*, Mr L. Richardson, F.G.S. *(Hon. Secretary)*, Lieut.-Col. J. C. Duke, Dr E. W. Prevost, F.R.S.E., and Messrs W. Bishop, W. R. Carles, F.L.S., S. J. Coley, O. H. Fowler, J. W. Gray, F.G.S., J. N. Hobbs, G. W. Keeling, J. W. Skinner, V. A. Smith and W. Thompson. Dr C. G. Cullis, F.G.S., and Messrs E. T. Paris and Wainwright came as visitors.

Arriving at Hereford the Members were driven in breaks to what is usually spoken of as a gravel-pit, but the "gravel" appears to be a remainder of the Great Ice Age—a glacial moraine. It is situated about four miles from the city, a little off the road which conducts the traveller to Hay, and well in sight of the Black Mountains. The Rev. H. E. Grindley, who is responsible for this geological discovery, was Director of the party, and standing on the summit of the moraine he first described the physiographical features of the surrounding country. He said that at one time a large marsh stretched over much of the low-lying land, and even now it was known as Sugger's Pool. The glacial bank on which they were standing extended in a south-westerly direction, and at seven miles off they found a similar gravel-pit, whilst the country was marked by a ridge, the subsoil of which was covered with Silurian rocks. The hills in the distance were composed of Old Red Sandstone, denudation having been checked by an outcrop of corn-stone. A quantity of striated stones had been found in the moraine, and the rocks, which seem to have been brought from the north-west, were the deposition of rivers coming out of a glacier. The party then descended to the base of the exposed deposit, and Mr Grindley pointed out that whereas in river gravel-beds they met with clear stratification, here the rocks, consisting of sand and gravel, were all piled together tumultuously. He should say that the strong proofs of this being a moraine were (1) the chaotic nature of the deposit, (2) many of the stones were smooth and polished in part, but not in the

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characteristic way of water-worn pebbles, and (3) the moraine had the curved outline which they had learnt to associate with glacial action. Dr C. G. Cullis drew attention to the fact that the blocks of stone, whilst more or less angular, were polished in places, and agreed with Mr Grindley that this was a well-known feature of glacial action. Mr Gray said that if the gravel had been deposited by a river the stratification would have been more apparent. The Rev. H. H. Winwood said that wherever he had seen moraines he had found striæ on the stones. He was ready to admit there had been great disturbance at this place, and there was little sign of stratification, but he would like to be shown distinct evidences of striæ. Mr Winwood here pointed to a piece of Old Red Sandstone, and said he saw no striated marks. Very likely, replied Mr Grindley, because it was a local stone, but if Mr Winwood would hunt up some Silurian rock, which would have travelled a considerable distance, he would find it had had time to be scratched by the ice. This the Members proceeded to do, and without much difficulty pieces of stone were picked up bearing strong evidence of the rough treatment to which it had been subjected. The deposit is clearly very varied in character, and contains débris which has been carried from distant localities. As is generally known, the greater part of Britain was covered by ice, and the effect of the movement of the ice was necessarily to remove the soils and superficial deposits of the land-surface. In North Britain deposits of enormous depths were made, but as the glaciers did not extend over the southernmost part of the island, it stands to reason that there would be fewer proofs of their action in Herefordshire or Gloucestershire. The high grounds of Britain had their own independent ice, which, as the striæ show, radiated outwards, some of it passing westwards into the Atlantic, and some of it eastward into the North Sea. Glaciers perform two important tasks (1) to carry the débris of the mountains down to lower levels, (2) to erode their beds. On returning to Hereford, Mr Grindley showed Mr Winwood and one or two other Members who had hesitated to accept his theory off-hand, some striated stones brought from the moraine, and the local museum was able to adduce additional confirmation, so that in the end not only Mr Winwood but every geologist of repute present confessed that a good case had been made out. This is really an important matter so far as the West of England is concerned, and great credit is due to Mr Grindley for his patient research, and his able exposition of a difficult subject.

After a pleasant drive to Hereford, the Members sat down to lunch. A move was then made to the Cathedral, where Canon Williams was in waiting to exhibit and explain the wonderful Chain Library for which Hereford is famous. This proved a great treat, and the visit was rendered all the more enjoyable by reason of Canon William's geniality and enthusiasm for his subject. The library of priceless manuscripts, encased in strong covers, and chained to the original wood cases, dates back to the fourteenth century. As a matter of fact there are many more chains than books, but the surplus



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chains have been hung overhead in a conspicuous place. The greatest treasure is an Anglo-Saxon copy of the four gospels, dating back to the eight or ninth century. It was bequeathed to the Bishop of Hereford in 1050 as an old book. As is well-known, much time and labour were expended on these books, and one could but note that the illuminations and writing were as beautiful to the eye as in those far off days when monks must have believed that *laborare est orare*, or otherwise we should never have inherited such striking proofs of devoted industry. Another volume which may be associated with the aforesaid gospels is the beautiful 13th century Breviary, Hereford Use, with music interspersed. At the other end of the library is a Caxton "Legenda Aurea," 1483, one of the most perfect copies known, a Wycliffe Bible, 1420, and a Saxon Charter of date 840. Stroud visitors were interested in the grant of Robert de Berkeley to the Church of Leonard Stanley, of his woodland at Cowley, but the time was insufficient to allow of more than a cursory inspection of so many valuable relics.

Leaving the library, the Members were conducted by Mr Moore, Honorary Secretary of the Woolhope Naturalists' Field Club, round the exterior of the Cathedral, the cloisters naturally attracting attention. Returning to the interior of the building, the chief verger undertook the duty of director, and performed his task in a capable manner. Standing in the Lady Chapel, he drew attention to the fine clustered columns, and the other features of transitional architecture subsequent to the Norman, for which the choir and nave are famous. It may be here mentioned that the See of Hereford was detached from Lichfield in 673, Putta being its first bishop. The removal of murdered Ethelbert's body from Marden to Hereford led to the foundation of a superior church, reconstructed by Bishop Athelston, and burned by the Welsh in 1055. Recommenced in 1079 by the first Norman bishop, Robert of Lorraine, it was carried on by Bishop Reynelin, and completed in 1148 by Bishop R. de Betun. The lady chapel, clerestory of the choir, and north transept date from between 1226 and 1269, while successive additions and reconstructions have extended over 450 years. In 1786 the great western tower fell, and carried with it the west front and the first bay of the nave, since which date there have been two modern restorations, in 1842 and 1863. The total length of the Cathedral outside is 342 feet, inside 327 feet 5 inches, the nave being 158 feet 6 inches, the choir from screen to reredos 75 feet 6 inches, and the lady chapel 93 feet 5 inches. The pillars and arches of the nave, the north and south arches of the choir, and the triforium, are Norman in their architecture, as is also the font; the lady chapel, the clerestory, and stone vaulting, ea y English. The north transept is of the date of Bishop Aquablanca (1245-68), the south-east transept of late decorated. As the late Sir Gilbert Scott pointed out, but for the fall of the western tower, the consequent curtailment of the nave, and other solecisms, few cathedrals could offer so complete a field of progressive architectural study of Norman to late Perpendicular. The Cathedral can boast some fine

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monuments, notably St. Thomas of Cantilupe's shrine in the north transept, and Bishop Aquablanca's tomb.

The verger was perhaps happiest in his description of the famous "Mappa Mundi," drawn by Richard de Bello, of Lincoln, in the thirteenth century. It is a remarkable production, and has been made the subject of a learned treatise by the Rev. W. L. Bevan and Rev. H. W. Philpott, containing several pictorial reproductions. The author of the map, like his contemporaries, started with the assumption that the earth is flat, and as a natural consequence his study in geography, whilst extremely ingenious, and, as the verger made clear, distinctly humorous, possesses no more value for the modern student than the opening chapters of the Book of Genesis can be said to enlighten us on the creation of the world, and the creatures by which it is inhabited. The reverend gentlemen, who have spent considerable time in writing up this strange production, say:—"Viewed strictly in a geographical aspect, as a representation of the world at the time of its execution, the map would not repay anyone for the time spent in its study. Viewed, on the other hand, as a literary monument, on which is registered the position of learning towards the close of the 13th century, the map will be found worthy of examination." Making Jerusalem as his centre, the artist proceeded to give his conception of the land-surface, with the ocean surrounding the known world. In this way he imagines an earth-island, but of course his knowledge of the Bible led him to emphasise the Red Sea and the Mediterranean Sea, and he has been careful to trace the wanderings of the Children of Israel with mathematical exactitude. The east is placed at the head, the Terrestrial Paradise occupying the place of honour at the extreme top. We have here a striking example of the limitations of human knowledge in mediæval times, but nevertheless it is an evidence of one man's desire to play the part of instructor, and so fulfill his destiny to the best of his ability. A modern schoolboy would draw a more correct map of the British Isles than did old Richard de Bello, but that is because knowledge is progressive. The world is not flat, but holding such a belief, it is only natural that the Lincoln cartographer should produce a map which is highly valued by antiquarians.

Having inspected the crypt, and admired the brasses and numerous recumbent effigies of past Bishops of Hereford—(the verger made the remark: "Bishops are common in Hereford; we have them by the dozen")—the party passed to the Public Library and Museum, and here Mr Moore drew attention to the chief objects of interest. There is a fine collection of birds and Lepidoptera, and specimens from the moraine were eagerly scrutinised. Altogether, the excursion proved most instructive, and a fitting finale to a summer of useful and enjoyable work.

S. J. Coley and J. G. Wenden were elected Members.



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# ON A SECTION OF THE UPPER LIAS AT STROUD

BY

**CHARLES UPTON**

(Read 14th March, 1905.)

Although the Upper Lias is well developed in the neighbourhood of Stroud, it rarely happens that a good opportunity is afforded of studying it in detail. Recently, however, during the re-building of some houses at the junction of King Street and High Street an excavation was made in the lower part of the formation which displayed an excellent section of the bottom beds and their junction with the marlstones of the Middle Lias. I availed myself of the opportunity to compare this section with some in other more favoured localities.

The late Edwin Witchell in his work on the "Geology of Stroud" has but little to say with reference to the Upper Lias of the neighbourhood. He gives a general section without details, in which he assigns to the whole formation a thickness of about 68 feet, and he reproduces one of Dr. F. Smithe's sections of the Upper Lias of Churchdown Hill. Dr. Smithe's sections—which will be found in the Proceedings of the Club[1]—comprise only the

1 Proc. Cotteswold Nat. F.C., vol. xi., pp. 250-251.

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lower part of the formation, and are practically equivalent to the beds exposed in the section in King Street, Stroud. The lower part of the general section given by Witchell, that is,

| Ft. | Ins. | |
|---|---|---|
| 10 | 0 | Bands of argillaceous limestone |
| 8 | 0 | Brown friable shaly clay |

appears to refer to the same beds. No part of either the Churchdown or King-Street sections appears to include anything equivalent to any portion of the upper 50 feet given by Witchell.

One of the most complete and interesting sections of the Upper Lias of the South of England is that at Ilminster recorded by the late Charles Moore in his well-known paper "On the Middle and Upper Lias of the South-West of England," published in the Proceedings of the Somersetshire Archæological and Natural History Society for the years 1865-6[1]. I adopt the Ilminster section[2] as a standard for the purpose of correlation, and as the paper is somewhat inaccessible, I here reproduce the section, merely inverting it so as to have the oldest beds at the bottom as in nature, retaining however for the sake of reference Moore's stratigraphical terms and index letters.

SECTION AT ILMINSTER—MOORE.

*C.—The Upper Cephalopoda Beds*

| | Ft. | Ins. |
|---|---|---|
| q.—Eight bands of clay and stone. *Ammonites insignis*, *A. variabilis* and *A. Moorei*... about | 2 | 0 |
| p.—Light blue clay, with *Crania Moorei* ... ... | 0 | 4½ |
| o.—Three layers of drab-looking clay and stone ... | 0 | 9 |
| n.—Light blue clay ... ... ... ... ... | 0 | 3 |
| m.—Rubbly brown stone ... ... ... ... | 0 | 4 |
| l.—Gray clay ... ... ... ... ... ... | 0 | 5 |
| k.—Rubbly stone ... ... ... ... ... | 0 | 4 |
| i.—Gray clay ... ... ... ... ... ... | 0 | 3 |
| h.—Stone ... ... ... ... ... ... | 0 | 3½ |

1 Vol. xiii., p. 119.
2 Except for the omission of a few unimportant words.

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| | Ft. | ins, |
|---|---|---|
| g.—Gray clay ... ... ... ... ... ... | 0 | 4 |
| f.—Stone ... ... ... ... ... ... | 0 | 1½ |
| e.—Blue mottled clay... ... ... ... ... | 0 | 3 |
| d.—Rubbly stone ... ... ... ... ... | 0 | 3 |
| c.—Concretionary blue clay ... ... ... ... | 0 | 9 |
| b.—Layer of stone ... ... ... ... ... | 0 | 1½ |
| a.—Yellow and green clay. Zone of *Rhynchonella Bouchardi* ... ... ... ... ... | 0 | 2 |
| *B.—The Saurian and Fish Zone* | | |
| c.—Clay above fish-bed ... ... ... ... | 0 | 2½ |
| b.—The saurian and fish-bed—a yellow nodular, or septarian limestone, with enclosed organisms | 0 | 4-5½ |
| a.—Bed of clay beneath the fish-bed ... ... | 0 | 3 |
| *A.—The Leptæna Beds* | | |
| e.—Greenish clays divided by a thin irony band, the Zone of *Leptæna* [*Terebratulina*] *granulosa*, *Spiriferina Ilminsterensis* and *Zellania liassica* | 0 | 6 |
| d.—Greenish clay. Zone of *Alaria unispinosa* ... | 0 | 2 |
| c.—Dark brownish clay. Zone of *Thecidium rusticum* | 0 | 4 |
| b.—Variegated yellow and green laminated clay ... | 0 | 1 |
| a.—A band of yellow clay resting immediately upon the Middle Lias. The Zone of *Leptæna* [*Koninckella*] *Bouchardi* and *L.* [*Cadomella*] *Moorei* ... ... ... ... ... ... | 0 | 2 |
| *The Middle Lias* | | |
| f. Bed of ferringinous stone, the highest member of the Middle Lias ... ... ... ... | 0 | 5 |
| e. A bed of greenish marl. *Belemnites paxillosus* ... | 0 | 4 |
| d. The Marlstone ... ... ... ... ... | 10 | 0 |

With regard to the strata in Moore's division C, I am informed by Mr S. S. Buckman, that the identification *A. Moorei* is inaccurate. $C^q$, that is, the upper beds of the Ilminster Upper Lias, are the equivalents of the Cotteswold Sands and lower part of the Cotteswold Cephalopoda-bed. The strata lettered by Moore as $C^p$ to $C^a$ would represent the zones of *A. bifrons* and *A. falcifer*. None of these beds were exposed in the Stroud section, having been removed by denudation in comparatively recent times. About a year ago the zones of *A. bifrons* and *A. falcifer* were proved at Painswick, by a well-sinking.[1]

1 Proc. Cotteswold Club, vol. xv., p. 208.

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The details of the section referred to in the opening paragraph are as follows :—

SECTION AT KING STREET, STROUD.

| | | | Thickness in Feet | inches | |
|---|---|---|---|---|---|
| SURFACE SOIL | | Grey clay—probably redeposited Upper Lias | 1 | 0 | |
| | | Red gravelly bed, subangular pebbles of Oolite | 0 | 8 | |
| UPPER LIAS | | | | | |
| SAURIAN-ZONE | 1. | Clay with uneven top | 1 | 0 | *Dactylioceras Raquinianum*, d'Orb., *Hildoceras* sp.; Lignite; Ostracoda; Foraminifera. |
| | 2. | Band of grey rock | 0 | 2 | |
| | 3. | Clay | 1 | 2 | |
| | 4. | Two rock-beds with clay parting | 0 | 8 | |
| | 5. | Clay, grey at bottom, yellow at top | 1 | 0 | |
| | 6. | Rock band | 0 | 2 | |
| | 7. | Grey clay | 0 | 6 | |
| | 8. | Rock band | 0 | 2 | |
| | 9. | Grey clay | 0 | 8 | |
| | 10. | Rock band | 0 | 2 | |
| | 11. | Clay, grey at the top, yellow at base, obscurely stratified and having a conchoidal fracture when dry | 2 | 0 | |
| PAPER-SHALES | 12. | Shales, lower 18 inches dark blue, then dark brown, getting darker towards the top. Regularly-bedded, splitting into thin laminæ. Bedding wavy in upper portion; occasional lenticular marly concretions in upper third | 4 | 2 | *Harpoceras* sp., *Inoceramus dubius* (very abundant); Fish-remains; Lignite. |
| *LEPTÆNA*-BEDS | 13. | Blue clay charged with iron-pyrites | 1 | 4 | *Terebratula globulina*, *Rhyn. pygmæa*, *Thecidella* sp., *Orbiculoidea orbicularis*, *Koninckella Bouchardi*, *Cadomella Moorei*, Ostracoda; Foraminifera; small echinoids; *Plicatula spinosa*, *Chirodota* sp. |
| | 14. | Pale yellow nodular clay, with black veins, resting upon an uneven surface of the rock-bed (a) of the Middle Lias | 0 | 6 | |
| MIDDLE LIAS | | | | | |
| MARLSTONE | a | Pale nodular rock band | 0 | 8 | |
| | b | Bed of red irony sand with belemnites | 0 | 6 | |
| | c | Thick rock-bed of Middle-Lias Marlstone. | | | |

The Beds in this section which I have numbered 1 to 11, and possibly also No. 12, would appear to be the equivalents of Mr Moore's division B, and those numbered 13 and 14 of his division A.

Assuming that my identification is correct, we have at Stroud upwards of 15 feet of strata which are represented at Ilminster by only 2 feet 2 inches. At Churchdown the

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equivalent beds are, according to Dr. Smithe, represented by about 10 feet 6 inches, and at Alderton according to the same Author by upwards of 30 feet.

The *Leptæna*-Beds lie immediately upon the Marlstone of the Middle Lias. Insigificant though they are in thickness, from their persistence over a large area, and peculiar fauna, they are of great interest. Although so thin they contain quite a large number of fossils peculiar to themselves, among which are *Koninckella Bouchardi*, *K. liassiana* and *Cadomella Moorei*, diminutive survivors of the *Athyridæ* and *Leptæridæ* of the Palæozoic Rocks. *Terebratula globulina* and *Rhynchonella pygmæa* are confined to these beds, as are also *Koninckella Bouchardi* and *Cadomella Moorei*, which appear to be characteristic of the lower portion, and *K. liassiana*, which occurs at the top.

Moore gives a somewhat lengthy list of fossils from the *Leptæna*-Beds of Ilminster in which locality they have a particularly rich fauna. Unfortunately owing to the equivalent beds at Stroud only being available for a very short time, I was not able to make anything like an exhaustive list of the fossils, but amongst those which I did obtain are *Ter. globulina* and *Rhyn. pygmæa* (both usually crushed), *Koninckella Bouchardi*, *Cadomella Moorei*, *Orbiculoidea orbicularis* and *Thecidella sp.* The beds have also produced some half-dozen species of Ostracoda, and considerable numbers of beautifully perfect Foraminifera of probably upwards of a dozen species. In Mr Moore's paper he refers to the myriads of spines and plates of echinoids which are found in these beds at Ilminster. The same remark would apply equally to the upper blue-bed (No. 13) at Stroud, indeed the finer portion of the washings consists very largely of microscopic echinoid spines.

One striking difference between the Ilminster and Stroud beds is the abundance in the former of the genus

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*Thecidella* and their almost entire absence from the latter, indeed I have found only one single valve.

The *Leptæna*-Beds have been recorded throughout the entire length of the western edge of the Cotteswolds, but they do not appear to occur to the eastward. They also occur in Calvados (Normandy) where the brachiopod fauna is particularly rich.

Immediately upon the *Leptæna*-Beds come about 4 feet of shales—the "Paper-Shales" of Brodie. Except in the upper 8 or 10 inches the lamination is very well marked, and the central portion when dried can be split into very thin laminæ. The upper beds when wet are a dark chocolate colour, and appear to contain a considerable quantity of oil. Throughout the shales flattened specimens of *Inoceramus dubius* are particularly conspicuous, and there are also many specimens of an ammonite not unlike *Harpoceras exaratum*, Young and Bird. Fragmentary fish-remains also are common. Foraminifera and Ostracoda are very rare if not altogether wanting, nor have I seen any remains of Algæ. Long needle-like spines of *Acrosalenia crinifera*, Wr., and impressions of plates are common on the surfaces of some of the shales. It is doubtful if these shales are represented by any deposit in the Ilminster district, but they have been recognised at Churchdown, Alderton, and Dumbleton. The upper 10 or 12 inches of the shales are irregularly bedded, and pass somewhat gradually into the amorphous clays which overlie them.

As will be seen from the section above, there are upwards of 7 feet of these grey clays with 6 rock bands at intervals. With the exception of Foraminifera and Ostracoda in some of the clays, fossils are rare in these beds. *Dactylioceras Raquinianum* and *Hildoceras* sp. are the only ammonites recorded. Isolated blocks of lignite occur in the clays and also in the shales. In the

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corresponding beds at Churchdown there is a very conspicuous band of rock which has been identified as the "Saurian and Fish-Bed" of Moore, but although there are in the Stroud section no fewer than six beds of rock somewhat similar in appearance, I have failed to find anything in them which would justify the correlation of any one of them with the Churchdown and Ilminster Saurian and Fish-Bed. Nevertheless I consider that the series should be correlated with that zone. Some of the clay beds have a conchoidal fracture. I have washed portions of the most promising looking clays, and although they contain a considerable number of Foraminifera and Ostracoda, the small interesting Brachiopoda of the *Leptæna*-Beds are entirely absent. Foraminifera, though fairly abundant in some of the beds of clay, comprise fewer species than the *Leptæna*-Beds. The Nodosarian group, which is most abundant in the *Leptæna*-Beds, is almost wanting, whereas *Cristellaria*, which is comparatively infrequent in the *Leptæna*-Beds, is extremely common in the upper beds of clay. *Rhynchonella Bouchardi*, which marks a thin clay-bed in the Ilminster district, appears to be absent from the Cotteswolds.

The upper portion of the clay-beds (Saurian Zone) has been subjected to denudation and is quite uneven, the denuded surface having a general slope towards the north, on which side lies the valley through which the Slad stream flows. Along the whole of the face of the section which was exposed there extended a thin bed of coarse sub-angular gravel, nowhere more than 8 inches in thickness, composed of fragments of oolite embedded in reddish marl, and upon the top of this another clay-bed which had obviously been disturbed and may possibly have been placed there when the original buildings which occupied the site were erected. At any rate it was clearly not an original undisturbed deposit.

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# ON A WELL-SINKING IN THE UPPER LIAS AT PAINSWICK, NEAR STROUD.

BY

L. RICHARDSON.

Exposures of the Upper-Lias clays are not numerous in the Mid-Cotteswolds, and therefore it is particularly desirable that whenever the beds are exposed to view, their lithic and faunal characters should be carefully noted.

Miss M. K. Hutton, of Harescombe, having informed me (in 1905) that a well had been sunk in an orchard at a house called "Stamages" (less than a quarter of a mile south-south-west of Painswick Church) and showed me some fossils that she had found there, I asked Mr Paris to visit the locality and see if any further information was to be obtained. He procured a few more fossils and noticed that the well had been sunk in blue clay that contained a few small concretions.

In the Cotteswold Hills the Upper Lias (Toarcian) is seen to pass from an almost wholly arenaceous to a completely argillaceous development. In the Stroud district, according to Witchell, the clay portion is 68 feet thick and the sand about 100 feet. Judging from the evidence which has been obtained at Chalford, Nailsworth, and now at Painswick, the clay portion was laid down during the hemeræ *falciferi*, *bifrontis*, *Lilli* and *variabilis*. The well at "Stamages" was sunk in the *falciferum*- and *bifrons*-beds, the clay excavated yielding, in addition to the zonal ammonites, *Harpoceras* aff. *falciferum* (Sow.), *Dactylioceras* cf. *commune* (Sow.), *D.* cf. *bollense*, Zieten, *Belemnites tripartitus*, Schloth., *Zeilleria Darwini* (Desl. *non* Dav.), ? *Terebratula Jauberti*, Desl., *Inoceramus dubius*, Sow., *Nuculana Hausmanni* (Rœmer), and fish-remains.

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# A COTTESWOLD BRACHIOPOD: A FORGOTTEN NAME AND A NEGLECTED AUTHOR,

BY

S. S. BUCKMAN, F.G.S.

(Read November 14th, 1905)

The adventures of a species in the matter of nomenclature, and the difficulty of arriving at the correct designation even of a well-known form, are particularly exemplified in the following case.

In the year 1825, James de C. Sowerby figured, and named as *Terebratula acuta*, a Jurassic species, which he said was "presented by Miss E. Warne, who obtained a good series from ochraceous Limestone at Cleeve Hill, near Cheltenham, in 1820" (Min. Conch. v, p. 166.) He failed to notice that his father had, some years before, given the same name to another shell—the well-known Middle Lias fossil. Later he discovered this; and so he gave to his own fossil the name *Terebratula angulata*—so Davidson tells us, but he does not say where or when Sowerby did this; but it was in the Alphab. Index, p. 9, Vol. vii, of the Min. Conch., published according to Renevier in March, 1840.[1]

1 E. Renevier, Date de la Publ. des espèces ..... Conch. Min. ..... Sowerby; Bull. Soc. Vaudoise, 1855. My thanks are due to Mr C. D. Sherborn for kindly lending me a copy of this very rare and important pamphlet

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This designation was no more fortunate, for there was already a *Terebratula angulata* employed by Valenciennes (in Lamarck, "Anim. sans Vertèbres") who turned the *Anomia angulata*, Gmelin, over to the genus *Terebratula*.

About the year 1845, Thomas Brown, in his "Fossil Conchology," noticing that *T. acuta* was a double, gave to J. de C. Sowerby's species the designation *T. acuta-plicata*. He says nothing about Sowerby's correction, but he employs the name *T. angulata* for a Carboniferous species=*Anomia angulata*, Linné, which if it be the same as *Anomia angulata*, Gmelin, would seem to be rightly entitled to the name.

In 1850, both the Jurassic and the Carboniferous species appear in d'Orbigny's "Prodrome" as *Rynchonella angulata*. In 1851, the Jurassic species, and in 1858, the Carboniferous one, occur in Davidson's classic "Monograph of Brachiopoda" under the same designation; but, in 1858, Davidson notices the double use of the term *Rh. angulata*. In 1884, in the index to his Monograph he accordingly alters the name of the Jurassic species to *Rh. angulina*. He quite overlooks Brown's name *acuta-plicata*, which he ought to have employed. In fact, nobody seems to have attended to what Brown did—there almost seems to have been a conspiracy of silence about his work. But Brown's name must take precedence of Davidson's *angulina*; and as *acuta* and *angulata* were already occupied, Brown's name is quite valid.

In the same index, and because of the change of *R. angulata* to *R. angulina*, Davidson altered the name *R. subangulata* to *R. subangulina*. But there was no need in any case to do this. He first used the name *Rh. subangulata* for a species in Proc. Dorset Field Club, 1877, Vol. i, p. 83; and the name would not be affected by the fate of *angulata*.

A summary of results and other particulars will be

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found at the end of this note; meanwhile a few words about Brown and his work may be of interest.

Captain Thomas Brown, M.P.S., etc., was curator of the Museum of the Manchester Natural History Society. He was a diligent student of, and writer on, recent and fossil Conchology. His work on the latter subject is a quarto volume of about 275 pages and 116 plates crammed with coloured figures. He says, in fact, that it contains 3,521 figures, all engraved from drawings made by himself. The task was immense: the object most laudable—to bring into the compass of a volume descriptions and figures of all the fossils of the British Isles. Probably no other work accomplishes this so fully up to its date—it appeared in parts in various years up to 1849. For a general geologist the work should have been, and should be even now, very useful. Yet it has met with strange neglect. Everyone seems to have thought that it was nothing more than a compilation—copies of the figures of other authors, with nothing original in the way of nomenclature. They overlooked the fact that Brown had detected mistakes, had given new appellations when necessary, and in a few cases had introduced original figures and descriptions. Yet, so far as I have investigated, in the standard catalogues and indexes of names, there is no mention of Brown's terms. I confess that the work has lain for years almost neglected on my shelves. It was Mr C. D. Sherborn, F.G.S., F.Z.S., the great bibliographer, who kindly drew my attention to it, and to the necessity of doing justice to Brown. There are others of his Brachiopod names which require notice; and it will perhaps repay workers in other groups of fossils to look up what Brown has down in their departments.

The same Capt. Thomas Brown edited and annotated with many interesting remarks an issue of Gilbert White's "Natural History of Selborne." The second edition of

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this issue was published at Edinburgh, and bears date 1834.

Since the above was written Mr C. D. Sherborn has kindly given me a copy of his recent pamphlet on "The Conchological Writings of Capt. Thomas Brown" (Proc. Malacol. Soc. vi, 358, 1905). From this it can be seen that the Fossil Conchology began in 1837 and ended 1849; and that pp. 117 to 136 were issued in 1845. Therefore p. 138 containing *T. acuta-plicata* would be about 1845 or 1846; but exact dates after p. 136 are not yet available.

Mr Sherborn notices that practically nothing is known about the life of Thomas Brown—not enough for mention to be made of him in the Dictionary of National Biography. Mr Sherborn "will welcome further information."

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## Summary

*Rhynchonella acutiplicata* (Brown) is the designation for the common Cotteswold species which has so often figured in literature as *Rhynchonella angulata*, and is quoted in Richardson's Handbook Geol. Cheltenham as *R. angulina*. Its history is:—

| | | |
|---|---|---|
| 1825 | *Terebratula* | *acuta*, J. de C. Sowerby (non J. Sowerby) |
| 1840 | „ | *angulata*, J. de C. Sowerby (non Valenciennes) |
| 1845-6 | „ | *acuta-plicata*, Brown |
| 1850 | *Rhynchonella* | *angulata;* d'Orbigny |
| 1851 | „ | *angulata;* Davidson |
| 1884 | „ | *angulina*, Davidson |
| 1905 | „ | *acutiplicata* (Brown) S.B. |


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## Index Details

### RHYNCHONELLA ACUTIPLICATA (*Brown*)

*T.d.* J. de C. Sowerby, 1825, Min. Conch. v., p. 166; (*Terebratula acuta*, non J. Sowerby).
*T.f.* Ibid. Pl. 502, fig. 4 (Holotype).
*Nom.* T. Brown, Foss. Conch. [1845-6] (*Terebratula acutiplicata*) Pl. lv*, figs. 98, 99, copy af Sowerby's figure, and p. 138, his description in other words.
*T.l.* Cleeve Hill, near Cheltenham
*Hor.* "Ochraceous Limestone" [Upper *Trigonia*-Grit, Upper Inferior Oolite (Bathonian)]
*η.* [*Garantianæ.*]
*Syn.* *Terebr. angulata*, Sow., non Val., *Rh. angulata*, Davidson, et auctt., *Rh. angulina*, Dav. et auctt.

NOTE.—As the Holotype is the specimen figured and described by Sowerby, and as Brown's figure is only a copy of Sowerby's, the older author's figure and description are entitled to be considered as the *T. f.* and *T. d.* respectively. Really all that Brown did was to change the name, and to alter slightly the wording of the description.

### RHYNCHONELLA SUBANGULATA, *Davidson*

*T.d.* Davidson, 1877, Brach. of Bradford Abbas, etc.; Proc. Dorset Field Club, I., p. 83.
*T.f.* Ibid. Pl. iv., figs. 11, 12 (Syntypes), "*Rhynchonella angulata*, Sow."
*T.l.* Bradford Abbas, Dorset.
*Hor.* Inferior Oolite [Paving Bed, Lower Inferior Oolite, Aalenian].
*η.* [Murchisonæ].
*Syn.* *Rh. angulata*, var. *subangulata*, Dav., *Rh. angulina*, var. *subangulina*, Dav.

NOTE.—Not a variety of *R. angulata* (*acutiplicata*) as it lived long before it. Besides it probably belongs to quite another genetic series. *R. subangulata* is a multiplicate derivative of *R. acuta* through *R. cynocephala*; *R. acutiplicata* is more allied to the *R. concinna* group.

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## Explanation of Contractions

*T.d.*, Type-description, or Protolog[1]; *T.f.*, Type-figure or Protograph[1]; *T.l.*, Type-locality; *Nom.*, Named by; *Hor.*, Horizon; *η.*, Hemera; *Syn.*, Synonym.

1 See, Science N.S. Vol. xxi, pp. 899-901; and Ann. Mag. N.H., (S. 7) Vol. xvi, p. 102, 1905.



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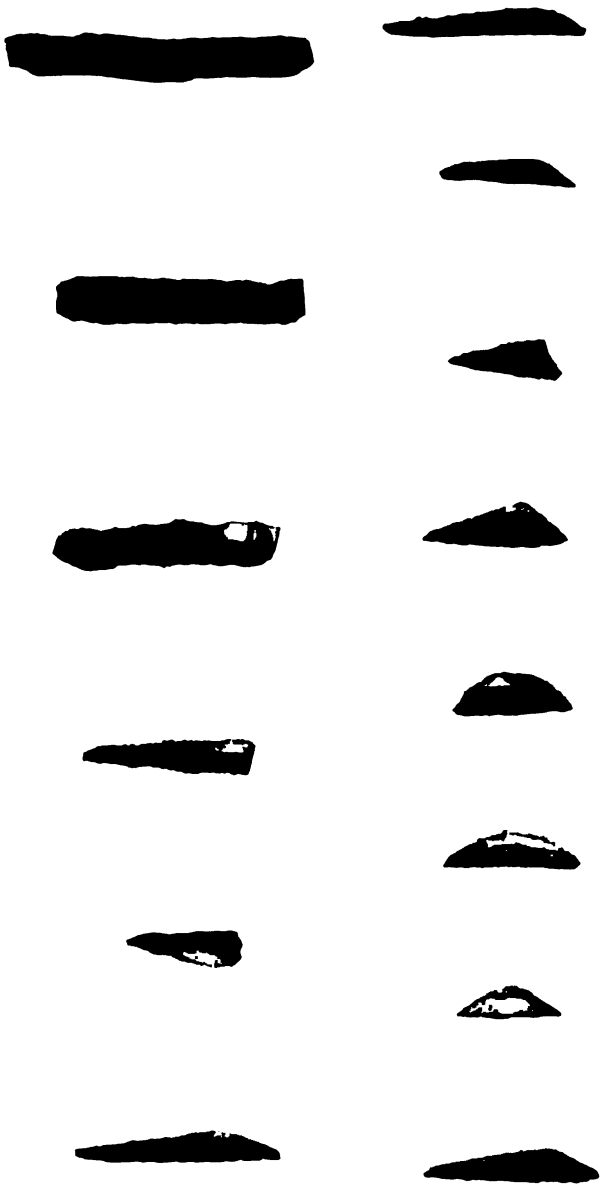

PYGMY FLINTS

From Caves in the Vindhya Mountains, India, now in the National Museum, Dublin.

*(Natural size)*

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# PYGMY FLINTS

BY

**VINCENT A. SMITH, M.A., I.C.S. (Retd)***

(PLATE IX)

(Read January 9th, 1906.)

The convenient name of "Pygmy Flints" has been given to a series of extremely minute stone implements of peculiar forms, discovered first in India, and subsequently in Egypt and Europe. The term must be understood as being merely descriptive of the small size of the objects, and not as meaning that they are the work of a race of pygmies.

These minute implements were first noticed by the late Mr A. C. Carlleyle, of the Archæological Survey of India, at a place called Sohâgî Ghât, on the northern scarp of the Vindhya Mountains, about thirty miles from Allahabad, in the cold season of 1867-8. Subsequent researches in the years 1880 and 1881 by the same explorer brought to light vast numbers of the "pygmies" in caves and rock-shelters, in the "Vindhyan Sandstone" of the Vindhya and Kaimûr ranges. Mr Carlleyle never published his discoveries, but after his death, some of his notes and collections came into the hands of the late M. Seidler, Curator of the Museum at Nantes. A copy of his notes has been communicated to me by the Rev. A. Gatty, of Hooton Roberts,

*[Abstract of a paper read at a meeting of the Cotteswold Naturalists' Field Club held at Gloucester on the 9th January, 1906. The complete essay, dealing in detail with the Indian side of the subject, will appear in the *Indian Antiquary*, Bombay, during 1906. This abstract is concerned more particularly with the English phenomena.]



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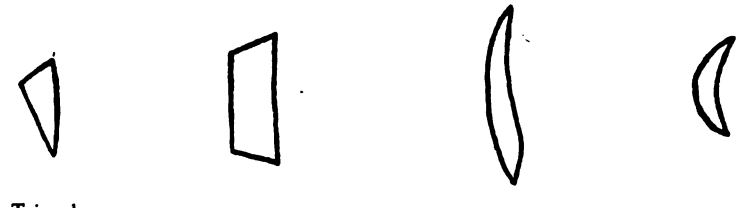
Yorkshire, who has made a special study of the subject, and has corresponded freely with me.

Mr Carlleyle obtained the bulk of the little implements by digging in the earth or gravel on the floors of the caves and rock-shelters, which varied in depth from six inches to four feet. At a medium depth, undisturbed layers of embers and charcoal, marking the position of ancient hearths, were frequently found. The implements in the lowest stratum of the floors were of a more archaic type than the rest. The "pygmies" were often accompanied by lumps of hæmatite, partially decomposed, and extremely archaic drawings of hunting scenes made with that pigment were sometimes observed on the cave walls. No ground or polished implement was ever associated with the "pygmies," but in some of the caves fragments of very rude pottery, presumably hand-made, were found, and one cave was filled with pottery and ashes, and nothing else.

Several tumuli in the neighbourhood which were excavated contained entire skeletons, accompanied by pottery, minute stone-implements, and flakes identical with those of the caves. Of course, there was no trace of metal.

The material of the minute implements is flint (chert), agate, jasper, or chalcedony. The special forms are four in number, which may be indicated roughly in outline as below:



Triangle (Scalene) 1 — Trapezoid 2 — Point 3 — Crescent 4

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The triangular and crescentic forms are well shown in the accompanying plate, photographed from some of Carlleyle's specimens in the National Museum, Dublin, by kind permission of Mr George Coffey. The plate does not include any trapezoidal forms, but three of the "points" are fairly characteristic. The three larger specimens at the top of the left column are merely ordinary small implements, not in any way characteristic.

The best locality in England for the special Indian forms is Scunthorpe in Lincolnshire, where Mr Gatty has found large numbers of implements, even smaller than the Vindhyan ones, on the floors of old habitations in depressions of an extensive deposit of wind-blown sand. The neighbourhood of Scunthorpe is level for the most part, but a ridge of hills rises abruptly from the plain, and extends to Lincoln for a distance of thirty miles. The "pygmies" have been excavated at seven isolated sites, some in the plain and some on the hills. On the floor of one habitation Mr Gatty obtained considerably more than two hundred implements. A bed of peat, in which a horn and part of the skull of *Bos primigenius*, the urus, have been discovered, underlies the sand. The "pygmies" are found only on the old floors under the sand, and not either in the peat or in the superincumbent sand. But, in the Pennine Hills, Dr Colley March obtained similar implements *below* ten feet of peat.

The difference in size between the Scunthorpe and Vindhyan examples of the four characteristic forms is shown in a table prepared by Mr Seidler as follows:

| | | Vindyhan (smallest) | Scunthorpe (smallest) |
|---|---|---|---|
| 1. | Triangle (scalene) ... | ... $\frac{10}{16}$ inch | ... $\frac{3}{16}$ inch |
| 2. | Trapezoid ... ... | ... $\frac{8}{16}$ " | ... $\frac{6}{16}$ " |
| 3. | Rounded and pointed | ... $\frac{10}{16}$ " | ... $\frac{4}{16}$ " |
| 4. | Crescent ... ... | ... $\frac{8}{16}$ " | ... $\frac{6}{16}$ " |

The extremely minute scale of the Scunthorpe examples

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is specially distinctive of that locality, and any explanation of the use of "pygmies" must be good enough to cover the smallest Scunthorpe specimens. The trapezoidal and crescentic forms, abundant in the Vindhyas, are scarce at Scunthorpe. The four forms to which reference has been made above are by no means the only ones.

"It is astonishing," Mr Gatty writes, "what quantities of small flints you get with secondary working upon them. Tiny hollow scrapers , chisels , square [sic] scrapers , and innumerable points with bulb of percussion. . . There are no end of nameless pieces with secondary work on them, showing they have been in use and that a very plentiful supply was kept up. I think if you saw the big collection I have, and the absolute difference between these flints and ordinary neoliths, you would agree that they are a distinct class made by a distinct people. . . I have found 'Anglo-Indian pygmies' at Hooton, and up on the Pennines at Bradfield. It was Dr Colley March at Rochdale who made the great discovery under the peat. I have seen these, and they are true Vindhya Hill and Scunthorpe varieties. . . It is true you find Neolithic knives and scrapers—very small—in all places; but the real article is utterly different. Besides the places mentioned I only know Lakenheath [near Brandon in Suffolk,] as a real 'pygmy' locality. Sevenoaks and Hastings, perhaps [as well], but I have not seen the best examples from these."[1]

No cores have been found at Scunthorpe, although Mr Carlleyle obtained numbers of them in India, and they also occur in Belgium, where they measure about an inch in height. The core found by Sir John Evans at Weaversthorpe in Yorkshire, which is only ·85 inch high, evidently was used for the manufacture of minute implements like the "pygmies." (*Anc. Stone Impl.*, 2nd ed., p. 276, fig. 189.)

The foreign sites for "pygmies" are numerous. Dr Sturge, of Nice, who possesses an exceptionally fine collection of large and small flint implements, found, as

1 For Hastings specimens, see Evans, *Ancient Stone Implements*, 2nd ed., p. 325, fig. 232 A.B.C., compared with Vindhyan examples, fig. 232, D.E.F. Evans' notes give most of the references to the printed information on the subject. The British Museum has a set from Dr Colley March's find.

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Mr Gatty informs me, "vast quantities" of Indian types of "pygmies" in a very restricted area at Helwân (Helouan) in Egypt, and is much impressed by the "very localized" distribution of the implements of this class in all parts of the world where they have been found. Mr Reed mentions Palestine, North Africa, and Southern Spain as countries where minute flint implements occur, but I am not sure how far the specimens from all these localities exactly agree with the Vindhyan and Scunthorpe forms. There is, however, no doubt that true "pygmies," exhibiting the same peculiarities as those from India and Lincolnshire, are found abundantly at certain limited localities in Belgium, chiefly in the province of Namur, between the town of that name and Dinant, distant about fifteen miles to the south. The Belgian finds have been well described and beautifully illustrated by M. de Pierpoint.[1]

The crescent-shaped implements, about half an inch in length, do not seem to be common in Belgium, but are found at Cave No. 3 of Goyet, which is considered to belong to the age of the mammoth. Similar implements occur in the French province of Dordogne, and at several Spanish localities, including Aguilar in Murcia.

The Belgian "piercers," that is to say, delicately worked, straight-pointed flakes, are believed to have been made during the long time extending from the end of the Quaternary period to the Neolithic Age, and seem to have been contemporary with the mammoth and rhinoceros. The trapezoidal or rhomboidal forms, although rare in the valley of the Meuse, are found at a place called Sarts à Soile (Bois Laitrie, Rivière,) where M. de Pierpoint found 10,000 flakes and small chips in a space of sixty square mètres. A few sites furnish both piercers *(petites pointes)*

1 Observations sur de Très Petits Instruments en Silex, provenant en plusieurs Stations Néolithiques de la région de la Meuse." (*Bull. Soc. Anthrop.*, Bruxelles, tome xiii., 1894-5).

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and polished Neolithic axes. But in general, the ordinary Neolithic implements seem to occupy stations distinct from those of the "pygmies."

"Cette industrie," M. de Pierpoint observes, "bien que datant de l'âge actuelle ne peut se confondre avec celle de l'âge de la pierre polie. C'est l'œuvre d'une peuplade se distinguant absolument de celle qui créa la civilization dite rohenhausienne [scil. Swiss Lake dwellings]. . . Ce n'est pas un peuple conquérant, mais une race refoulée, qui tend à s'éteindre."

These observations of the Belgian scholar to some extent support Messrs J. A. Brown and R. A. Gatty in their belief that the "pygmies" are the work of a special race that emigrated from the East and made its way as far as Lincolnshire and Yorkshire. The latter gentleman is convinced that the Indian and Scunthorpe "pygmies" agree so exactly that the agreement can be explained only by the assumption that a "migration took place in the Stone Age." He argues that we "have to consider that four types are repeated, and, allowing for accidental similarity, it is hard to credit that four different implements should occur in both places [England and India] exactly alike." If we make the ordinary assumption that the people in India and England unconsciously adopted the same forms because they were living in similar conditions, with similar needs, and the same material for supplying them, it is reasonable to point out that the conditions of a Lincolnshire plain differ widely from those of the Vindhyan hills. Moreover, the manufacture of "pygmies" is by no means co-extensive with the Neolithic civilization. It is, on the contrary, strictly localized, and the "pygmy" stations are often quite unconnected with, or, if near to, are quite distinct from Neolithic stations of the ordinary kind. The "pygmies" are not merely small examples of the common-place Neolithic stock-in-trade. At Scunthorpe and other places where their peculiarities are plainly marked, they form an

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independent series of special forms of arrow-heads, borers, scrapers, and other tools, which suggest the furniture of a doll's house. The profusion in which these little implements occur is also held to be an indication that they are the work of a separate race. It does not seem likely that the Neolithic man, accustomed to the use of full-sized tools, whether chipped or polished, would sit down and manufacture as an extra these tiny implements to such an extent that hundreds are found on the floor of a single hut.

These arguments, although obviously not without force, have failed to convince either Sir John Evans or Mr C. H. Read. The former authority observes (*loc. cit.*) that "curiously enough, identical forms have been found in some abundance on the Vindhyan Hills and [in] the Banda District, India, at Helouan (Helwân,) Egypt, and in the district of the Meuse, Belgium. Such an identity of form at places geographically so remote does not imply any actual communication between those who made the tools, but merely shows that some of the requirements of daily life, and the means at command for fulfilling them being the same, tools of the same character have been developed, irrespective of time and space."

In the same sense, Mr C. H. Read remarks that "the curious persistence of the same forms in all these countries [India, Egypt, England, Belgium, etc.] has led to the conjecture that they are the work of one and the same race; but the same argument might be used to prove that the barbed stone arrow-heads of Europe, Japan, and North America were the productions of a single people. However it may be explained, the similarity of form is sufficiently striking to deserve careful attention."[1]

It is needless to dwell on the difficulties of Mr Gatty's

1 *Guide to the Antiquities of the Stone Age in the British Museum*, 1902, p. 110. Mr Read gives illustrations of seven Scunthorpe "pygmies."

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migration theory; but, while freely admitting them, I do not feel quite satisfied with the explanation given by Sir John Evans and Mr Read. I am disposed to think that M. de Pierpoint's remark previously quoted to the effect that the "pygmies" are the work, not of a conquering race, but of a retreating people on the verge of extinction, points to the true solution of the problem. I suspect that the "pygmy" makers were a subject population dependent on the more aggressive, combatant people who used the ordinary Neolithic implements. Such dependent communities, with women specially trained in the art of making delicate implements, as a domestic industry, might not be universally distributed throughout the Neolithic world, although existing in many widely separated places. The big and the little implements would be found together or in separate stations according as the conquering race and the dependent race were intermixed or lived in distinct settlements. In India at the present day, as a speaker pointed out at the meeting, subject races constantly are required to occupy distinct sections of a village, or even separate villages. Conquering Neolithic immigrants, who had not brought the dependent race with them, or had not found them in possession, would have no "pygmy" implements in the settlements, but, wherever the dependents were settled, those implements would be found, and the miniature tools, produced in enormous quantities, would have formed a very valuable addition to the mechanical resources of the community as a whole. This hypothesis seems to me to supply a reasonable explanation of the erratic distribution of the "pygmy" implements in the world, and more especially in the valley of the Meuse.

We must now briefly consider the uses to which stone implements ranging in length from three-sixteenths of an inch to an inch could be put. The first fact to remember

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is the vast quantity in which they were produced. Carlleyle found five hundred "crescents" in a single cave, and similar abundance has rewarded the researches of Mr Gatty, M. de Pierpoint, and Dr. Sturge. Consequently, the little tools must have served the requirements of daily life, and any explanation must be inadequate which assigns to them only highly specialized functions of rare and exceptional use. They may have been, and no doubt were, used for trepanning, tattooing, and such special purposes. But even Neolithic man was not always being either tattooed or trepanned, and the thousands of implements found must have served much more general purposes. It is quite clear that implements found in such quantity on the floors of dwellings were not merely amulets or intended for symbolical use at funerals or other ceremonies, like the miniature pottery sometimes found in pre-historic graves. They must have been made for human nature's daily needs.

The suggestion has been thrown out that women may have been specially employed in their manufacture, and it is clear that many of the implements, if properly fitted with holders, are well adapted for stitching and piercing purposes in domestic economy. That hint explains a good deal, but not everything. The scalene triangle forms are exactly suited to make barbs for arrow- or spear-heads, when fitted into grooves in the manner indicated in Mr Read's figure 118, or the similar illustration in the work of Montelius entitled "The Civilization of Sweden in Heathen Times." Other forms are plainly suitable for use as arrow-heads, and even the crescentic shapes may have been utilized sometimes in that way, although Sir John Evans does not accept the suggestion. Clearly such minute tools could not have been used except when fitted into handles and holders of various forms. Egyptian examples of wooden sickles with flint teeth are known.

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Bone remains not having been discovered in connection with the "pygmies," the probability is that the latter were ordinarily fitted to wooden holders and then utilized as saws, weapons, and, in short, for every purpose to which man can apply an edged, pointed, or toothed tool. As Sir John Evans has pointed out (*op. cit.*, p. 293), Australian savages make knives or saws by attaching small flakes of flint in a row in a matrix of resin at one end of a stick, and spears are formed in the same manner. Occasionally, flakes of quartz or other silicious material were mounted at the end of short handles by the Australians, so as to form a kind of dagger or chisel.

Without further search for illustrations in detail, we may, I think, be satisfied to hold that the "pygmy flints," even the smallest, were big enough to make serviceable implements, when properly set with suitable adhesives in various kinds of holders and handles. I agree with M. de Pierpoint that they are not the sort of implements likely to be used by a conquering people. I doubt if weapons made with such small flints could have been of much use either in war or against the larger mammals, but they were well adapted for killing birds and "small deer."

Thus the question of use touches that of origin, and we seem almost driven to the conclusion, suggested by Mr Brown and M. de Pierpoint, and further developed in this paper, that the "pygmy flints" are the work of a race (or races), which retreated before the advancing Neolithic users of big stone weapons, sometimes remaining associated with the conquerors, and sometimes dwelling quite apart.

I am not satisfied that Sir John Evans' theory about "similar requirements" adequately explains the facts, and I am inclined so far to agree with Mr Gatty as to think it probable that the "pygmies" are the work of a weak, dependent race which either entered Europe along with

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conquering Neolithic man, or was found by him in occupation of certain localities. I abstain from further speculation as to the direction or nature of ethnic movements in the Neolithic period. It does not seem likely that the evidence ever will suffice to prove clearly what such movements were, or how they took place. But I venture to throw out the further suggestion that the "pygmy flints" may be regarded as the last effort of the weak Palæolithic man who was over-borne by the superior strength and resources of his Neolithic successor. The finding of two dolichocephalic skulls in the neighbourhood of a "pygmy" station in Belgium led M. de Pierpoint to remark that that was a case of "the Palæolithic race being interred in the midst of the Neolithic civilization." That remark, I am disposed to think, has a wider bearing than its author intended. The wide gap between Palæolithic and Neolithic man usually assumed cannot really have existed, for nature abhors gaps, as she does a vacuum. Provisionally, therefore, I would ascribe the "pygmies" to Palæolithic slaves and subjects of Neolithic man. I cannot agree with the view which, according to Mr Reed, is generally held, that the "pygmies" should be assigned to the Neolithic (*i.e.*, late Neolithic) or the "Bronze Period."

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# INSTINCT

BY

**Professor C. LLOYD-MORGAN, LL.D., F.R.S.**

(Delivered February 20th, 1906)

(REPORT BY LECTURER)

As a technical term "instinct" is applied to certain modes of behaviour which are characterized by the fact that they are not the outcome of individually-won experience, but are due to inherited connections which have been established within the central nervous system. Through some biological means there has been a preparation of the organism of such a kind that when a presentation from the environment occurs, affording grouped sensory stimuli, there follows an application of the vital energies of the organism in behaviour appropriate to the circumstances. For instinctive activities the preparation has been racial; it is independent of any preparation of the individual through its personal experience. The presentation is some group of circumstances affecting the sense-organs. The application is always, under normal conditions, adaptive, and of such a kind as to further the life of the individual or the race. For example the chick inherits an organization of such a kind as to prepare it to respond adaptively to the sight of small objects by pecking at them, and seizing them in the bill; the duckling is biologically prepared for the special stimulations presented when it is placed in

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water. The application in this latter case is the instinctive act of swimming.

In plants and in some of the lower invertebrate animals there is in like manner an hereditary preparation to respond adaptively by certain applications of the vital energies when the appropriate presentations occur. Thus the stem of the seedling grows upward in a direction opposite to that of gravitative attraction (negative geotropism). Plants in the cottagers' windows grow towards the light (positive heliotropism). There are a number of such "tropisms" dependent upon racial preparation; they show adaptive applications of organic behaviour, which follow on specific presentations of environing circumstances. In what respect do these tropisms differ from modes of instinctive activity? The question is difficult to answer. As a provisional reply it may be said that instinctive behaviour affords a basis for intelligent behaviour. The animal may profit by the experience gained in the performance of instinctive activities. Thus the chick instinctively pecks at small grains, but some of these are nice, some are not. The pecking responses are modified in accordance with the experience they afford. It would seem that such ability to profit by experience is connected with the possession of a nervous system. There is at present no evidence that plants are able to profit by experience and to modify behaviour in accordance therewith. We may say then, provisionally, that tropisms afford examples of application as the outcome of racial preparation; but that instincts imply *also* an accompaniment of conscious experience and are susceptible of modification in accordance with the nature of that experience. This opens up a psychological as well as a biological aspect of instinct. Biologically, instinctive behaviour is due to racial preparation, and is prior to any individual experience: psychologically, it affords certain data to experience, and thus lays

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the foundations on which intelligent modifications of behaviour are based. Granting that the newly-hatched duckling is a conscious organism, then when it is placed in water it is aware of the situation, the sight of water, the stimuli it affords to breast and legs, in a word the presentation as a whole; it is also aware of the instinctive behaviour, the application of the energies involved in the act of swimming. All these data afforded to consciousness coalesce into what may be termed the primordial tissue of experience.

The aim of observational work and research in the field of instinct has been first, to determine what modes of behaviour are prior to individual experience, and secondly, in what way they themselves afford a preparation for further application in the modification of behaviour through intelligence. [Examples were given from the lecturer's work on *Animal Behaviour*.]

From the strictly biological point of view, the phenomena of instinct must be brought into relation with evolutionary doctrine. If they involve what has been termed racial preparation, the questions arise: How has this preparation been established, and in what manner has it been transmitted through heredity? We have seen that instinctive behaviour may be modified by intelligent profiting by individual experience. The main question is as to the hereditary transmission of such acquired modifications of behaviour. Lamarck held that it was through such transmission that instincts have had their origin. George Henry Lewes termed it "lapsed intelligence." Darwin showed that many instincts could not have arisen in this way. He held that the majority were due to natural selection—that is to say, to the occurrence of slight variations in the efficiency of racial preparation and the elimination of all save those which were the most adaptive. Romanes classified as follows:



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(1) primary instincts due to natural selection; (2) secondary instincts due to lapsed intelligence; and (3) instincts of blended origin. Professor Weismann has advocated the view that all true instincts are due to natural selection. With this view the lecturer concurs. But he has endeavoured to show that, though intelligent modifications are not directly inherited, they may indirectly foster the congenital variations on which the origin of instincts depends. The lecturer proposed to deal with this hypothesis at greater length in a future address.

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# SOME LIAS AMMONITES: *SCHLOTHEIMIA* AND SPECIES OF OTHER GENERA,

BY

**S. S. BUCKMAN, F.G.S.**

(Plates X, XI.)

(Read, March 20th, 1906)

## Genus.—SCHLOTHEIMIA, *Bayle*, 1878.

Genotype—*Schlotheimia angulata*, Bayle (non Schlotheim) = *S. depressa*, Quenstedt-Wähner, *teste* Pompeckj.
Ref. 1878. Explic. Carte Géol. France, iv, Pl. lxv.
1879. Bull. Soc. Géol. France, (3) Vol. vii, p. 91. Type given as "*A. angulatus*, Schl."

The genus *Schlotheimia* was treated monographically by Hyatt.[1] He recognised about 22 species, giving full descriptions of most of them. Pompeckj also described the species of the same genus, so far as the Swabian fauna was concerned[2]; and out of 16 species which he recorded, he registered 12 by name: four of these are new to Hyatt's list, so that makes 26 species of *Schlotheimia*. But Canavari had previously noted 13 Italian species as belonging to *Schlotheimia*[3]: most of these are

1 1889, Genesis Arietidæ; Smithsonian Contrib. 673.
2 Rev. Amm. Schwäb. Jura, I., 1893.
3 Amm. Lias Spezia; Palæontographica, xxix, 3., 1882. Also R. Com. Geol. d'Italia, vol. iii, 1888.



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dwarfs, and nearly all must be added to Hyatt's list. With other species which were not noted by these authors, and with those which have been named since, it may reasonably be surmised that the genus *Schlotheimia* contains nearly 50 species. Of all these forms only 6 were recognised as British by Wright[1]; but that states the case inadequately to our present knowledge. We can now note some 27 species as British. The difference between these numbers is but an imperfect measure of how much remains to be done before the Ammonite fauna of the British Lias is adequately described and figured. For the present investigation was primarily concerned only with the small species allied to *S. lacunata*, because Mr Richardson had discovered several forms which he wished to record; and little attention was given to the large species of the *angulatus*-group—little more than to include a few notes made during the course of various researches to simplify a somewhat complicated synonymy.

For assistance in this investigation my cordial thanks are due to Mr J. W. Tutcher, for the trouble he has taken to give such excellent photographs; and also to him, to Dr Charles Schuchert, Yale University Museum, U.S.A., Dr F. L. Kitchin, Jermyn Street Museum, London, Mr H. Woods, M.A., F.G.S., Sedgwick Museum, Cambridge, Mr L. Richardson, and Dr A. Vaughan, F.G.S., for the kind loan of various specimens.

## Affinities and Development.

*Schlotheimia* is connected by its suture-line with the genera *Psilonotoceras*, Quenstedt (*Psiloceras* being invalid through prior use); *Wæhneroceras*, Hyatt; *Caloceras*,

1 Monogr. Lias Ammonites (Pal. Soc.)

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Hyatt; *Alsatites*, Haug. In all these genera the inner portion of the suture-line is dependent,—that is it runs back and has the lobes pointing across the whorl. This feature separates these genera from the family Arietidæ; they must not be placed as forerunners of the Arietidæ, as Hyatt did; they form a family by themselves, as I pointed out[1]; but the name Psiloceratidæ then proposed must drop with *Psiloceras*, so the name **CALOCERATIDÆ** may be suggested

The five genera may be easily distinguished:—*Psilonotoceras* is uncarinate, and has a smooth periphery; in side ornament the genus develops catagenically from costate to levigate—*Caloceras* is an anagenetic genus, developing from smooth to costate to tuberculate, and in periphery, from rounded to carinate, to carinatibisulcate—*Alsatites* is like *Caloceras*, but has a more complex suture-line—*Wæhneroceras* is uncarinate, but the periphery is crossed by costæ—*Schlotheimia* is a development from the lower Wæhneroceratan forms, the costæ on the periphery becoming broken until a regular furrow is formed.

Hyatt divided the *Schlotheimiæ* into two subseries; and certainly the dwarf species typified by *S. lacunata* differ much from the *Angulatus*-group, suggesting some difference in genetic development. Quenstedt proposed the generic name *Angulaticeras* for the Schlotheimians—1883, Schwäb. Amm. i, p. 26. If, as seems likely, the Schlotheimians are to be further divided generically, then Quenstedt's name, as he selected no type, would be available for the group of *A. lacunatus*; he mentions that as a species of *Angulaticeras*.

Hyatt's idea that *P. planorbis* is the ancestor of the Arietidæ, including *Schlotheimia* and its allies, cannot be accepted. In the first place the peculiar suture-line of

1 Divisions of so-called Jurassic Time; Quart. Journ. Geol. Soc., vol. liv, p. 445, 1898.

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*Psilonotoceras*, *Schlotheimia*, *etc.*, shews that they are quite unconnected with the Arietidæ. Next *P. planorbis* is most unlikely to be the ancestor of the Schlotheimian group (Caloceratidæ) for it is a catagenetic species, obviously declining from the costate stage to the levigate, having nearly passed out of the costate stage, in fact. What is wanted is an anagenetic species which is passing from the levigate to the costate—the morphic equivalent to *Arnioceras semicostatum;* earlier than that, an anagenetic smooth species, equivalent to the Arietidan *Arn. miserable;* earlier again a smooth globose species, equivelent to the Arietidan *Cymbites*. Out of the *Arn. semicostatum* equivalent would come an anagenetic costate species, equal to *C. Johnstoni;* and, out of such a form, the Caloceratidæ could be developed. Only, *C. Johnstoni* itself cannot be placed as such an ancestor, because it is later in date than *Psilonotoceras;* a *C. Johnstoni* morphic equivalent is the ancestor.

Similarly with the Arietidæ, *Cymbites*, *Arn. miserable*, *Arn. semicostatum* indicate the anagenetic stages leading up to *Coroniceras;* but they are not the actual ancestors, as they occur later: it is their morphic equivalents—species with the same simple, not dependent suture-line—that are the actual ancestors.

Then *Asteroceras* is not an anagenetic series, but a catagenetic one, going from tuberculate *(=Coroniceras)* as the inner whorls of *Ast. obtusum* shew, to the costate. The more tuberculate ancestor of *Ast. obtusum* is figured by Wähner as *Arietites stellæformis*, Gümbel.[1]

Another Arietan genus, *Oxynotoceras*, is a highly accelerated catagenetic series, mainly in the levigate stage.

1 Zonen des Unt. Lias; Pal. Œst.-Ungarns, vol. vi, (4) Pl. xlv, fig. 2, 1888.

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## Description of Species.

### *1 Group of S. angulata (Schlotheim)*

1. SCHLOTHEIMIA STRICKLANDI, sp. n., Pl. XI, f. 5, 6.

*Description*:—Whorls narrow, much compressed, inclusion very little. Ribs at first small, numerous, approximate, later few, distant, subprominent. Umbilicus wide, flat. Periphery narrow, subacutely rounded, ribs mostly obsolescent thereon, but a few cross it at intervals.

*Remarks*:—Is like *A. prometheus*, Reynès, but has far fewer coils in the umbilicus.

The specimen which forms part of the Strickland collection in the Sedgwick Museum, Cambridge, is labelled "Cracombe." That is near Evesham, Worcestershire, and the horizon would be Lower Lias, (Hettangian); *angulatus*-zone probably.

2. SCHLOTHEIMIA ACUTICOSTA *(Strickland-Buckman)*.[1] Pl. XI, f. 1, 2.

*T.d.* 1844, J. Buckman, Geol. Chelt., Ed. ii, p. 103.
*T.f.* None.
*T.l.* Coltknap Hill, near Evesham.
*Hor.* [Hettangian, *angulatus*-zone?]

The following is the original description:—

"*Ammonites acuticosta* (Strickland)—Back with a single furrow, which in the young shell is somewhat broad and flat, in older shells nearly obsolete. Volutions 4 or 5, compressed, almost wholly exposed, the sides with numerous regular, simple, very acute ribs, commencing at the inner margin of the whorl, curving forwards, gradually at first, and more so as they approach the dorsal furrow, where they are met, with great regularity, by corresponding ribs on the opposite side, exhibiting a sagittate or "*herring-bone*" figure. In large specimens, the ribs on

1, I suggest this plan to shew the giver of the name and the first describer of the species. It indicates Strickland MS. described by Buckman.

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the opposite sides are almost confluent, nearly obliterating the furrow. There are from 35 to 40 of these ribs on the outer volution, which occupies about three-eighths of the whole diameter. Aperture, oblong-quadrate, diameter about two inches, thickness half an inch."

*History*:—There are three syntypes in the Strickland Collection, Sedgwick Museum, Cambridge. From these syntypes one is now chosen to be the lectotype of the species. Of the others, 1 = *S. prometheus*, Reynès, 2 = *Wæhneroceras* sp.

A fragment of a small specimen obtained by Mr L. Richardson from a well at Ennick Ford, Humblebee Hall, near Upton Snodsbury, Worcestershire, agrees in costation and general contour with this species. Whether it is stout enough to be identical is difficult to say, the materials for comparison being so deficient.

3. SCHLOTHEIMIA ÆQUALIS *(Simpson)?*

*Ægoceras catenatum;* Wright, (non Sowerby), Mon. Lias Amm. 1880, Pl. xix, figs. 5-7, may represent this form, judging by what Blake says (Yorkshire Lias, p. 271). At any rate it is not Sowerby's species, and is very distinct from anything else.

4. SCHLOTHEIMIA PROMETHEUS *(Reynès)* Pl. XI, f. 3, 4.

*T.d.* None.
*T.f.* 1879, Reynès, Monogr. Amm., Pl. iii, figs. 1-10. (Ammonites prometheus).
*Syn.* Ammonites acuticosta, Strickland MS., J. Buckman, Geol. Chelt., Ed. ii, 1844, p. 103, pars.

Thinner and less coarsely costate than *S. æqualis* as interpeted by Wright's figure. Strickland's fossil is from " Lower Lias, Coltknap Hill, near Evesham," and evidently, Hettangian, *angulatus*-zone.

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5. SCHLOTHEIMIA GALLICA, nom. nov.

1844, Ammonites catenatus; d'Orbigny (non Sowerby), Pal. franç., Ceph., Pl. xciv, figs. 1, 2 only.

As d'Orbigny's specimen does not agree in any way with Sowerby's species, a new name is necessary. Its ribs are more approximate and less distinct than in either *S. acuticosta* or *S. prometheus;* and its periphery is much smoother.

A fragment submitted by Mr Tutcher, last septal chambers and beginning of body-chamber of a specimen about 165 mm. diameter, agrees well with d'Orbigny's figures. It shows suture-line with very short lobes and wide, shallow saddles—very simple in comparison with that shewn in Pl. XI, f. 7.

6. SCHLOTHEIMIA ANGULATA *(Schlotheim)*

Wähner,[1] Hyatt[2] and Pompeckj[3] agree that the figures given by Wright (*Ægoceras angulatum*, Pl. xiv, figs. 5, 6, Monogr. Lias Amm.) represent Schlotheim's species.

7. SCHLOTHEIMIA COLUBRATA *(Schlotheim-Zieten)*

Hyatt says that the figures given by Wright, Mon. Lias Amm., Pl. xvii, figs. 1, 2, "Ægoceras angulatus = Ammonites Moreanus, d'Orbigny," represent *Am. colubratus*. Certainly they closely resemble Zieten's figure.

8. SCHLOTHEIMIA cf. EXECHOPTYCHA *(Wähner)*.

1863, Ammonites angulatus; Wright, Proc. Cotteswold Club, Vol. iii, Pl. i, f. 5.

1884, Ægoceras angulatum, Schlotheim, var. exechoptychum, Wähner, Unt. Lias; Pal. Œst.-Ungarns iv, Pl. xx, figs. 2-4.

The specimen figured by Wright, above quoted, has

1 Pal. Œst.-Ungarns, 1884.
2 Gen. Arietidæ; Smiths. Contrib. Know., 673, 1889.
3 Rev. Amm. Schwäb. Jura., 1893.

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much resemblance to Wähner's form especially to what he depicts in figs. 3, 4, but it differs somewhat in the contour of its umbilicus. It is an interesting specimen, and though only 45 mm. in diameter, it shews a complete mouth-border.

A specimen of Mr Tutcher's from Bitton, agrees with Wähner's Pl. xx, fig. 2.

9. SCHLOTHEIMIA EXTRANODOSA *(Wähner)*. Pl. XI, f. 7.

1884, Ægoceras extranodosum, Wähner, Unt. Lias; Pal. Œst.-Ung. iv, Pl. xx, f. 10.

A broken specimen of which Mr Tutcher has sent me a photograph closely resembles Wähner's species above quoted. "Bitton, angulatus-zone."

10. SCHLOTHEIMIA OBLONGA *(Quenstedt)*.

1883, Ammonites angulatus oblongus; Quenstedt, Amm. Schwäb, Jura, Pl. ii, fig. 6.

A fragment submitted by Dr A. Vaughan, from "angulatus-beds," near Sodbury, I identified with the above cited figure.

11. SCHLOTHEIMIA cf. STRIATISSIMA *(Quen.) (Hyatt)*.

1863, Ammonites angulatus; Wright (non Schlotheim), Proc. Cotteswold Club, Vol. iii, Pl. i, f. 4.

In the above Wright depicts a very remarkable fine-ribbed compressed *Schlotheimia*. It is nearest to *S. striatissima*, but is more compressed. I can find nothing else like it in literature.

A specimen 187 mm. in diameter, but much crushed and without central whorls, agrees closely with Wright's figure. It has, however, passed almost into the smooth stage. It was submitted by Mr Tutcher, from Hanham, near Keynsham, Somerset.

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12. SCHLOTHEIMIA CHARMASSEI *(d'Orb)*. Pl. X, f. 19, 20.

1880, Wright, Lias Ammonites, Pl. xx. Hyatt and Pompeckj accept this, excluding *S. d'Orbignyana*.

I have placed under this name a small specimen (Pl. X, figs. 19, 20), but I am inclined to think it is new. It is almost impossible to compare a small example like this (× 2 in Plate) with the drawings of large specimens. The ornament is somewhat similar in strength, but other details might be quite different. It is from " Lower Lias, Redcar [Yorkshire], Tate Collection," and is in Geol. Survey Museum, No. 14034.

What is shewn as the young form by d'Orbigny, Ceph. Jur., Pl. xci, figs. 1, 2, must certainly be excluded: Figs. 2, 4, must be taken as the type of his species. Figs. 1, 2 of Pl. xcii, have been already excluded by Hyatt; he founded thereon his *S. d'Orbignyana*.

13. SCHLOTHEIMIA BOUCAULTIANA *(d'Orbigny)*.

1879, Wright, Mon. Lias Amm., Pl. xviii. Hyatt and Pompeckj accept this; and it seems as if Wright's figs. 2, 3, were a redrawing of d'Orbigny's type specimen.[1]

*2 Group of S. sulcata (J. Buckman)*

14. SCHLOTHEIMIA JUGATA, *S. Buckman*.

*T.d.* 1904, Pal. Univ. 39[a].
*T.f.* Ibid. 39, T3.
*T.l.* Vale of Gloucester [near Cheltenham, Midland Railway Station].
*Syn.* *Ammonites sulcatus*, J. Buckman, Geol. Chelt., xi, 3.

15. SCHLOTHEIMIA SULCATA *(J. Buckm.)*, Pl. X, f. 9, 10.

*T.d.* 1844, J. Buckman, Geol. Chelt., p. 105, *Ammonites sulcatus*.
*T.f.* Ibid. xi, 2.
*T.l.* Vale of Gloucester [near Cheltenham, Midland Railway Station].
*Note.*—Type refigured, 1904, S. Buckman, Pal. Univ. 39, 2,

1 Pal. Franc. Ceph. Jur. Pl. xc, 1844.

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A FOREIGN SPECIES.

16. SCHLOTHEIMIA LACUNOIDES *(Quenstedt)*, Pl. X, f. 7, 8.

*T.d.* 1884, Quenstedt, Amm. Schwäb. Jura, i, p. 162. *Ammonites lacunoides.*
*T.f.* Ibid. Pl. xxi, fig. 24.
*T.l.* Ofterdingen.

Quenstedt's tiny fossil is difficult to identify. Pompeckj considers it identical with *S. rumpens;* but if I have identified it correctly it is much more coarsely costate.

Now that I have seen a German example I can say that the identification, queried at the time, of a Cheltenham specimen with this species was incorrect (Pal. Univ. 78, M3, 1905.) Our specimen, *S. cheltoniensis*, has a smaller and a more concentrically coiled umbilicus, a more pronounced furrow, and lacks little knobs on the inner margin which are so curious in the German fossil.

None of our English forms agree with the German specimen, which belongs to the Museum of Yale University, New Haven, U.S.A. It is figured as an interpretation of Quenstedt's species, and in the hope that English specimens may be found. It is labelled "Lias β [Sinemurian] Betzgenrieth."

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17. SCHLOTHEIMIA VENTRICOSA *(Sow.), (Canav.)*

1882, Ægoceras ventricosum; Canavari, Fauna Lias Spezia; Palæont. xxix, Pl. iv (xviii) fig. 3.

A small specimen 8 mm. in diameter, No. 14035 [a] in the Geol. Survey Museum, Jermyn Street, is very like Canavari's interpretation of Sowerby's species. It is from "Lower Lias, Redcar [Yorkshire], Tate Collection."

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18. SCHLOTHEIMIA COMPTA *(Sow.) (Canavari).*

1882, Ægoceras comptum; Canavari, Fauna Lias Spezia; Palæont. xxix, Pl. iv (xviii) fig. 5.

A small specimen 7 mm. diameter, in the Geol. Survey Museum, seems near to Canavari's above-cited figure; but it has rather less coarse ribs. It is from "Lower Lias, Redcar [Yorkshire], Tate Collection," and is No. 14035 [b].

19. SCHLOTHEIMIA MISCELLA *(Oppel)*

*T.f.* 1844, J. Buckman, Geol. Chelt., xi, 1. (*Ammonites sulcatus*).
*Nom.* 1862, Oppel, Pal. Mitth., iii, Jur. Ceph., p. 130, (footnote).
*T.l.* Vale of Gloucester [near Cheltenham, Midland Railway Station.]
*Note.*—Type refigured, 1904, S. Buckman, Pal. U. 39, 1, as *Schloth. subrotunda*, which becomes synonym.

*Remarks*:—Oppel named this species in a footnote. The practice of making alterations in nomenclature in footnotes is undesirable, because they are so apt to be overlooked. That has been the case here. Oppel named this and *A. rumpens* (p. 242) in the same footnote; but neither appeared in Hyatt's memoir, and *A. miscellus* was not noted in Pompeckj's paper. So Oppel's naming escaped my notice, and I happened to give another name to the same fossil. That name must of course drop.

There is a specimen in the Collection of the Geol. Survey, Jermyn Street, No. 14033. It is from "Lower Lias, Badgworth [Gloucestershire], Tate Collection."

20. SCHLOTHEIMIA CHELTONIENSIS, nom. n., Pl. X, f. 15, 16.

1905, Schlotheimia lacunoides?; S. Buckman (non Quenstedt) Pal. Univ. 78, M3, 3[a].

*Description*:—Compressed, more than half involute: somewhat coarsely subflexicostate; connaticostate; peripheral sulcation distinct.

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*Remarks*:—A German example (see p. 240) has shewn that the former identification is incorrect. So a new name is necessary.

*Distinction*:—It differs from *S. lacunoides* by a smaller umbilicus, a more pronounced peripheral sulcation, and that the ribs are joined rodwise around the umbilicus, not into knobs.

*Locality*:—Cheltenham, Sinemurian [*oxynoti* hemera ?]

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A FOREIGN SPECIES.

21. SCHLOTHEIMIA RUMPENS *(Oppel)*, Pl. X, f. 21, 22.

*T.d.* 1858, Quenstedt, Jura, p. 98, (*Am. lacunatus*, non J. Buckman).
*T.f.* Ibid., xii, 4.
*Nom.* 1862, Oppel, Pal. Mitth. iii, p. 130, footnote.
*T.l.* Fulbach.
*Hor.* Lias β. [Sinemurian].

The opportunity is taken to give figures (× 2) of a German example to compare with our English specimens. We seem to have nothing like it in this country.

The figured specimen and another much smaller form part of the Collection of Yale University Museum, New Haven, Conn., U.S.A., and are labelled "Lias β [Sinemurian], Betzgenrieth."

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*3 Group of S. lacunata (J. Buckman).*

22. SCHLOTHEIMIA LARVALIS, sp. n., Pl. X, f. 1, 2.

*Description*:—A small Schlotheimian with Lytoceratan aspect. Nearly smooth, only slight indication of ribbing. Umbilicus open, inclusion slight. A small depression

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along the middle of periphery, becoming more noticeable at the end of the whorl, indicates an incipient furrow.

*Remarks*:—Two small specimens are very distinct from any other *Schlotheimia;* but the peripheral depression indicative of a nascent furrow shews their connection. The specimens are presumably the immature form of a *Schlotheimia*, which however, did not grow much larger, perhaps. They shew what Hyatt calls persistence of the larval form. There is retardation in the development of the ribs, instead of acceleration of earlier inheritance, or tachygensis. So the almost smooth stage persists till the furrow commences, whereas in normal cases the costæ should develop before the furrow, as may be seen to be the case in *Wæhneroceras*, and in other species of *Schlotheimia;* and this agrees with the phylogeny of the group.

*Locality*:—From Gloucester Gas Works, (*Oxynoti-armati* hemeræ), Coll. of Mr L. Richardson.

23. SCHLOTHEIMIA GLEVENSIS, sp. nov., Pl. X, f. 11, 12.

*Description*:—Compressed, whorls half included; sub-flexi- and connati-costate; peripheral sulcus gradually becoming more distinct.

*Remarks*:—In degree of costation and stoutness of whorls similar to *S. cheltoniensis*, but whorls not so broad, and umbilicus larger. In these respects more like *S. lacunata*, but much more strongly costate. From *S. subdeleta*, more flexed, coarser costæ, and other features. The *larvalis* stage may be seen in the inner whorls. One specimen is between *larvalis* and *glevensis*, the ribs earlier than in the former but later than in the latter.

*Locality*:—"Gloucester Gas Works, (*oxynoti-armati* hemeræ)" (Mr L. Richardson).

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24. SCHLOTHEIMIA LACUNATA *(J. Buckman)*, Pl. X, f. 13, 14.

*T.d.* 1844, Geol. Chelt., New Ed., p. 105.
*T.f.* Ibid., Pl. xi, figs. 4, 5 (Syntypes). *Ammonites lacunatus.*
*T.l.* Railway cuttings, Vale of Gloucester.
*Note.*—Six metatypes figured Pal. Univ., 1905, 78. Of these 1 = *S. lacunata*, 2 = *S. subdeleta*, 3 = *S. cheltoniensis*, 4, 5 = *S. parva*, 6 = *S. subpolita.*

Several small specimens "Gloucester Gas Works *(oxynoti-armati* hemeræ)" (Mr L. Richardson).

25. SCHLOTHEIMIA SUBDELETA, nom. nov., Pl. X, f. 17, 18.

1905, Schlotheimia deleta?; S. Buckman (non Canavari), Pal. Univ. 78, M2, 1905.

*Description*:—Compressed, whorls half-included, recti- and connati-costate; peripheral sulcus sharply defined, distinct.

*Distinction*:—From *S. deleta*, the umbilicus is larger and has more turns. From *S. glevensis*, the straighter ribs are not so bold, nor so distant; the whorls are more compressed; the sulcus is more much definite.

*Locality*:—Lias, Cheltenham, presumably *oxynoti* hemera.

26. SCHLOTHEIMIA SUBSTRIATA, sp. nov., Pl. X, f. 3, 4.

*Description*:—Compressed; whorls about half-included; flexi- and connati-costate to subcostate.

*Remarks*:—Ribs decline rapidly, becoming very approximate and like coarse striæ.

*Distinction*:—A larger umbilicus and a different style of ribbing separate it from *S. deleta.*

*Locality*:—"Gloucester Gas Works *(oxynoti-armati-* hemeræ)" Mr L. Richardson.

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27. SCHLOTHEIMIA DELETA *(Canavari)*, Pl. X, f. 23, 23a.

*T.d.* 1882, Canavari, Lias Spezia; Palæont. xxix, p. 166 (44) *Ægoceras deletum*.
*T.f.* Ibid., Pl. xviii (iv), 13.
*T.l.* Parodi, near Spezia.
*Syn.* *A. lacunatus;* Dumortier, Et. Pal. ii, Pl. xxi, figs. 18-20, 1867; and *Ægoceras lacunatum*; Wright, Mon. Lias Amm., 1882, Pl. lvi, figs. 16-18.

Canavari figured only a fragment, so identification is difficult. He claims Dumortier's figures as belonging to his species; and Wright's figures appear to be copies of Dumortier's.

Accepting Canavari's claim, we can take Dumortier's and Wright's figures for comparison. Two specimens from "Gloucester Gas Works *(oxynoti-armati* hemeræ)," submitted by Mr Richardson agree well with these, and shew that my provisional identification (Pal. Univ. 78, M2, 1905) was incorrect.

28. SCHLOTHEIMIA PARVA, *S. Buckman*, Pl. X, f. 24, 24a.

*T.d.* 1905, Pal. U. 78[a].
*T.f.* Ibid. 78, M4, Holotype; M5, Paratype.
*T.l.* Railway cuttings, Vale of Gloucester.
*Hor.* [Sinemurian, about *oxynotus* zone].

Gloucester Gas Works *(oxynoti-armati* hemeræ) Mr L. Richardson.

29. SCHLOTHEIMIA SUBPOLITA, *S. Buckman*

*T.d.* 1905, Pal. U. 78[a].
*T.f.* Ibid. 78, M6.
*T.l.* Railway cuttings, Vale of Gloucester.
*Hor.* [Sinemurian].
*η.* *oxynoti*, about

30. SCHLOTHEIMIA ANGUSTISULCATA, *Geyer*

1886, Schlotheimia angustisulcata, Geyer, Ceph. Hierlatz; K. K. Geol. Reichsanstalt, Vol. xii, No. 4, Pl. iii, figs. 24, 25.



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One rather poor specimen in the Museum of the Geol. Survey, Jermyn Street, agrees closely with Geyer's delineations. It is from "Lower Lias [*oxynotus* zone], Robins Hood Bay [Yorkshire], Tate Colln.," and is numbered 14032.

WÆHNEROCERAS SP., Pl. X, f. 5, 6.

1844, Ammonites acuticosta, Strickland, MS., J. Buckman in Murchison, Geol. Chelt., Ed. ii, p. 103, pars.

*Description*:—Somewhat stout, compressed whorls, inclusion about ¾. Ribs subflexed, strong, numerous, umbilicus small, gradate; inner margin marked. Periphery tabulate, crossed by strong ribs which hardly bend forward.

*Remarks*:—One of the syntypes of Strickland's species; but very different from others. See Schlotheimia 1, 2, 4.

*Locality*:—"Lower Lias, Coltknap Hill, Evesham; Strickland Collection," in Sedgwick Museum, Cambridge.

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## Index and Synonymy.

Below is an index to the species referred to in this paper, as a guide to the changes of nomenclature involved. Incorporated are also some notes of various changes of nomenclature, not necessarily referred to now, but important in any identification of these species.

Synonyms are in *italics*, new names in **heavy type**. Species not yet known as British are marked F.

A comma between trivial name and author means that the author himself gave the name; a semicolon, that the author is using an already established name.

*Ægoceras angulatum*; Wright = S. angulata, S. colubrata.
" *angulatum*, var. *exechoptychum*, Wähner = S. exechoptycha.
" *Boucaultianum*; Wright = S. Boucaultiana.
" *catenatum*; Wright = S. æqualis.

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*Ægoceras charmassei ;* Wright = S. charmassei.
" *comptum ;* Canavari = S. compta.
" *deletum*, Canavari = S. deleta.
" *extranodosum*, Wähner = S. extranodosa.
" *lacunatum ;* Wright = S. deleta.
" *Moreanum ;* Wright (pars) = S. colubrata.
" *ventricosum ;* Canavari = S. ventricosa.

*Ammonites acuticosta*, Strickland-Buckman = S. acuticosta, S. prometheus, Wähneroceras sp.
" *angulatus ;* Wright, = S. exechoptycha, S. cf. striatissima.
" *angulatus ;* Quenstedt (Jura iii, 1.) = Wähneroceras subangulare.
" *angulatus*, var. *charmassei* ; Chapuis, Mém. Ac. Belg. xxxiii, 1861, iii, 4 = S. posttaurina, W. *teste* Wähner.
" *angulatus intermedius gigas*, Quen. = S. intermedia.
" " *striatissimus*, Quen. = S. striatissima.
" *anguliferus*, Phillips = S. angulatus, *teste* Pompeckj ; but = Ægoceras capricornu, *teste* Blake.
" *Boucaultianus*, d'Orb., Pl. xc. = S. Boucaultiana.
" " , d'Orb., Pl. xcvii., figs. 3-5 = S. Guidonii (Sow.) *teste* Canavari.
" *catenatus ;* d'Orb., Pl. xciv., figs. 1, 2 = S. gallica.
" " d'Orb., Pl. xciv., figs. 3-5 = S. compta (Sow.) *teste* Canavari.
" *charmassei*, d'Orb., Pl. xci., figs. 1, 2 = Schlotheimia sp.
" " d'Orb., Pl. xci., figs. 3-5 = S. charmassei.
" " d'Orb., Pl. xcii., figs. 1, 2 = S. d'orbignyana.
" *angulatus ;* Hauer, type of *A. marmoreus*, Oppel, 1862, Pal. Mitth. 130n.
" *colubratus*, Schloth.-Ziet. = S. colubrata.
" *lacunatus*, J. Buckman = S. lacunata.
" " ; Dumortier = S. deleta.
" " ; Quenstedt = S. rumpens.
" " *rotundus*, Quenstedt = S. rotunda.
" *lacunoides*, Quenstedt = S. lacunoides.
" *miscellus*, Oppel = S. miscella.
" *Moreanus ;* Hauer, " xv. 1-3 " = S. extranodosa (Wähner) *teste* Pompeckj ; 1, 2, more like S. exechoptycha in my opinion.
" " ; Hauer " xv, 3, 4," = S. ventricosa, *teste* Wähner and Canavari.
" *Prometheus*, Reynès = S. Prometheus.
" *rumpens*, Oppel = S. rumpens.
" *sulcatus*, J. Buckman = S. jugata, S. miscella, S. sulcata.

**Calloceratidæ**. Fam. Name, p. 233.

Schlotheimia acuticosta (Strickland-Buckman) p. 235, Pl. XI, figs. 1, 2.
" angulata (Schloth.,) p. 237.



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Schlotheimia *angulata;* Bayle = S. depressa, (Quen.) (Wähner), *teste* Pompeckj.
" æqualis, (Simpson)? p. 236.
" angustisulcata, Geyer, p. 245.
" boucaultiana (d'Orb.) p. 239.
" charmassei (d'Orb.) p. 239.
" **cheltoniensis** nom. nov., p. 241, Pl. X, figs. 15, 16.
" colubrata (Schloth.-Ziet.) p. 237.
" compta (Sow.) p. 241.
" deleta (Can.) p. 245.
" *deleta;* S. Buckman = S. subdeleta.
F " d'orbignyana, Hyatt, founded on *A. charmassei*, d'Orb., Pl. 92, figs. 1, 2.
" exechoptycha (Wähner) p. 237.
" extranodosa (Wähner) p. 238.
" **gallica**, nom. nov., p. 237.
F " geyeri, Hyatt, founded on *S. lacunata*; Geyer, Ceph., Hierlatz, Pl. iii, figs. 22, 23.
" **glevensis**, sp. nov., p. 243.
F " intermedia, Pompeckj, founded on *Am. angulatus intermedius gigas*, Quen., Amm. Schwäb. Jura, iv, 1.
" jugata, S. Buckman, p. 239.
" lacunata (J. Buckman) p. 244, Pl. X, figs. 13, 14.
" *lacunata;* Geyer = S. Geyeri.
F " lacunoides (Quen.) p. 240, Pl. X, figs. 7, 8.
" *lacunoides;* S. Buckman = S. cheltoniensis.
" **larvalis**, sp. n., p. 242, Pl. X, figs. 1, 2.
" miscella (Oppel) p. 241.
" oblonga (Quen.) p. 238.
" parva, S. Buckman, p. 245, Pl. X, figs. 24, 24a.
" prometheus (Reynès) p. 236, Pl. XI, figs. 3, 4.
F " rotunda, Hyatt, founded on *A. lacunatus rotundus*, Quen. Amm. Schwäb, Pl. xxii., figs. 5, 6.
F " rumpens (Oppel) p. 242, Pl. X, figs. 21, 22.
F " striatissima (Quenstedt) Hyatt, founded on *Am. angulatus striatissimus*, Quen. Amm. Schwäb. Jura, iii, 2.
" cf. striatissima (Quen.) p. 238.
" **stricklandi**, sp. nov., p. 235, Pl. XI, figs. 5, 6.
" **subdeleta**, nom. nov., p. 244, Pl. X, figs. 17, 18.
" subpolita, S. Buckman, p. 245.
" *subrotunda*, S. Buckman = S. miscella.
" **substriata**, sp. nov., p. 244, Pl. X, figs. 3, 4.
" sulcata (J. Buckman,) p. 240, Pl. X, figs. 9, 10.
" ventricosa (Sow.) p. 240.

*Wæhneroceras subangulare* (Oppel), founded on *A. angulatus*, Quenstedt, Jura. iii, 1.

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## APPENDIX

### A. FORFICATUS, *Strickland-Buckman.*

I took advantage of the opportunity of borrowing Strickland's types of *A. acuticosta*, to ask for the loan of his holotype of *A. forficatus*, which was kindly granted. As this species has never been figured, only described, it seems desirable to give a figure in the present communication. Both the person who named it and the specimen itself have much local connection with the Cotteswold Club; it is most fitting that the Club should figure such an interesting species.

### CORONICERAS FORFICATUM *(Strickland-Buckman)*

Pl. X., fig. 8, 9.

*T.d.* 1844, J. Buckman in Murchison, Geol. Chelt., Ed. 2, p. 104 (*A. forficatus* Strickland [MS.]).
*T.f.* None.
*Hor.* Lower Lias [Sinemurian, *rotiformis* hemera].
*Loc.* Eckington, [Worcestershire].

The following is the original description :—

"*A. fortficatus* (Strickland)—Back with three keels, the middle one the most prominent, with a well-marked furrow on each side. Volutions 5 to 6, almost wholly exposed, with numerous, not very regular, nearly straight, simple ribs, some inclined *backwards*, extending from the inner margin of the volution nearly to the outer keel. Of every three ribs, two are united at their outer ends by a prominent flattened tubercle, and may be compared to a pair of forceps, the third rib being single and alternating with the united ones: this arangement is not quite regular, as a single rib ending in a tubercle sometimes alternates with a plain one. The outer volution has about 36 ribs, and occupies about a quarter of the whole diameter; aperture nearly square; diameter about 2 inches; thickness half-inch."

The species is near to *A. sinemuriensis*, d'Orbigny (1844, Ceph. T. Jur., Pal. franc., Pl. xcv, figs. 1, 2), but is not so stout, or so broad in periphery, has less coarse, more approximate ribs, more backwardly directed; and the single ribs come in more frequently. It is more like

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*A. aussoniensis*, Reynès (1879, Mon. Pl. ix, fig. 14, 15), but that is not so rursicostate. In his Pl. xxv, Reynès called another form *A. aussoniensis;* but there has probably been a mistake in the lettering: it was perhaps intended that figs. 3, 4 should be *A. aussoniensis*.

## Explanations of Contractions.

*T.d.*—Type description or Protolog[1]; *T.f.*—Type-figure or Protograph[1]; *T.l.*—Type locality; *Nom.*—Named by; *Hor.*—Horizon; *η.*—Hemera; *Syn.*—Synonym.

## Postscript.

Since the above paper was in type Mr J. W. Tutcher has submitted an example of another species to add to our British list. It may be inscribed as

SCHLOTHEIMIA aff. LEIGNELETII (d'Orbigny)

It is a fragment, a half-whorl, of a specimen about 225 mm. in diameter. As d'Orbigny's type is only 35 mm. across, comparison is difficult. But the present specimen has ribs which are somewhat coarse—coarser than one would expect an aged *S. Leigneletii* to possess; while they are also coarser, more regular, and not spaced on inner margin as in *S. d'orbignyana*. This example of an oxynotoceratoid Schlotheimian is interesting. Its locality is near the Workhouse, Keynsham, Gloucestershire; and its date perhaps *rotiformis* hemera.

SCHLOTHEIMIA EXTRANODOSA (Wähner).

See page 238. Wright's *Æg. angulatum = Am. Moreanus*, (Mon. Lias Amm., Pl. xvii, figs. 5, 6, only) may be referred approximately to this species.

1 Science N.S. xxi, 899; Ann. Mag. Nat. Hist. (7) xvi, 102, 1905.

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# EXPLANATION OF PLATE X.

FIGS. 1, 2.—SCHLOTHEIMIA LARVALIS, sp. n., × 2.
Gloucester Gas Works, *oxynoti-armati* hemeræ: Collection, Mr L. Richardson
Fig. 1.—Side view. Fig. 2.—Front view.

FIGS. 3, 4.—SCHLOTHEIMIA SUBSTRIATA, sp. n., × 2.
Same place etc. as above.
Fig. 3.—Side view, Fig. 4.—Peripheral view.

FIGS. 5, 6.—WÆHNEROCERAS sp. = Am. acuticosta (*Strickland-Buckman*) one of the syntypes. Natural Size.
Lower Lias [Hettangian], Coltknap Hill, Evesham.
Fig. 5.—Side view. Fig. 6.—Peripheral view.

FIGS. 7, 8.—SCHLOTHEIMIA LACUNOIDES (*Quenstedt*), × 2.
Lias β [Sinemurian], Betzgenreith.
Collection, Yale University Museum.
Fig. 7.—Side view. Fig. 8.—Peripheral view.

FIGS. 9, 10.—SCHLOTHEIMIA SULCATA (*J. Buckman*), Natural Size.
Vale of Gloucester, [Sinemurian, *oxynoti* hemera].
Fig. 9.—Side view. Fig. 10.—Peripheral view.

FIGS. 11, 12.—SCHLOTHEIMIA GLEVENSIS, sp. n. × 2.
Gloucester Gas Works, *oxynoti-armati* hemeræ.
Collection, Mr L. Richardson.
Fig. 11.—Side view. Fig. 12.—Peripheral view.

FIGS. 13, 14.—SCHLOTHEIMIA LACUNATA (*J. Buckman*), × 2.
Vale of Gloucester, [Sinemurian, *oxynoti* hemera].
Fig. 13.—Side view. Fig. 14.—Peripheral view.

FIGS. 15, 16.—SCHLOTHEIMIA CHELTONIENSIS, sp. n. × 2.
Gloucester Gas Works, *oxynoti-armati* hemeræ.
Collection, Mr L. Richardson.
Fig. 15.—Side view. Fig. 16.—Peripheral view.

FIGS. 17, 18.—SCHLOTHEIMIA SUBDELETA, nom. nov. × 2.
Vale of Gloucester, [Sinemurian, *oxynoti* hemera].
Fig. 17.—Front view. Fig. 18.—Peripheral view.

FIGS. 19, 20.—SCHLOTHEIMIA CHARMASSEI (*d'Orbigny*) ?, × 2.
Lower Lias, Redcar, Yorkshire, Tate Collection in Museum Geol. Survey, No. 14,034.
Fig. 19.—Front view. Fig. 20.—Peripheral view.

FIGS. 21, 22.—SCHLOTHEIMIA RUMPENS (*Oppel*) × 2.
Lias β. [Sinemurian], Betzgenrieth.
Collection, Yale University Museum.
Fig. 21.—Side view. Fig. 22.—Peripheral view.

FIGS. 23, 23a.—SCHLOTHEIMIA DELETA (*Canavari*)
Gloucester Gas Works, *oxynoti-armati* hemeræ.
Collection, Mr L. Richardson.
Fig. 23.—Side view, Natural Size. Fig. 23a.—Ditto, × 2.

FIGS. 24, 24a.—SCHLOTHEIMIA PARVA, *S. Buckman*
Same place, etc., as last.
Fig. 24.—Side view, Natural Size. Fig. 24a.—Ditto, × 2.

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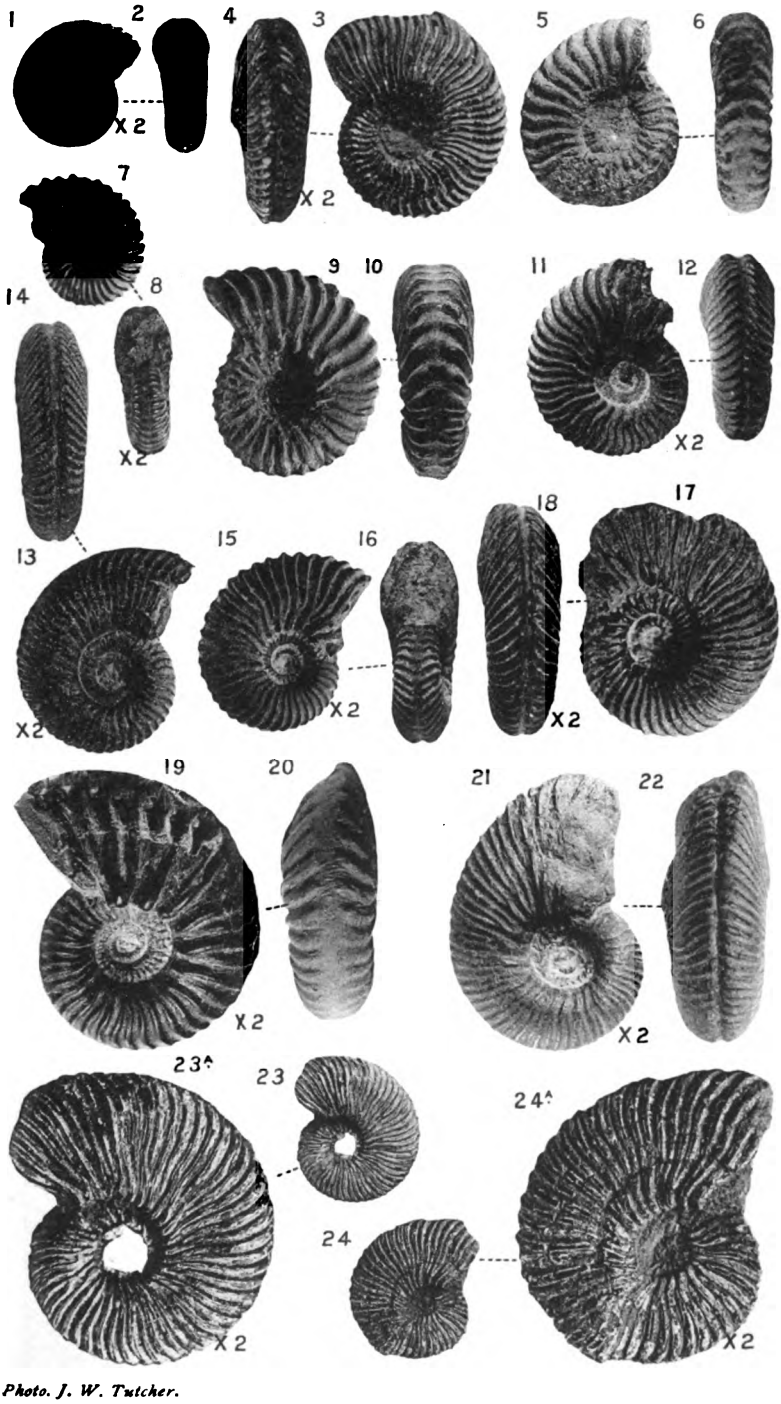


*Photo. J. W. Tutcher.*

SCHLOTHEIMIA, WÆHNEROCERAS

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## EXPLANATION OF PLATE XI.

FIGS. 1, 2.—SCHLOTHEIMIA ACUTICOSTA (*Strickland-Buckman*), one of the syntypes of *A. acuticosta*.

Lower Lias (Hettangian), Coltknap Hill, Evesham.
Strickland Collection in Sedgwick Museum, Cambridge.
Fig. 1.—Side view. Fig. 2.—Peripheral view.

FIGS. 3, 4.—SCHLOTHEIMIA PROMETHEUS (*Reynès*), with the last, and one of the syntypes of *A. acuticosta*.

Fig. 3.—Side view. Fig. 4.—Peripheral view.

FIGS. 5, 6.—SCHLOTHEIMIA STRICKLANDI, sp. n.

Lower Lias [Hettangian], Cracombe, near Evesham.
Same Collection as above.
Fig. 5.—Side view. Fig. 6.—Peripheral view.

FIG. 7.—SCHLOTHEIMIA EXTRANODOSA (*Wähner*)

Lower Lias [Hettangian], *angulatus*-zone, Bitton, Gloucestershire.
Collection, Mr J. W. Tutcher.
Fig. 7.—Side view.

FIGS. 8, 9.—CORONICERAS FORFICATUM (*Strickland-Buckman*).

Lower Lias [Sinemurian, *rotiformis* hemera], Eckington, Worcestershire.
Strickland Collection in Sedgwick Museum, Cambridge.
Fig. 8.—Side view. Fig. 9.—Peripheral view.

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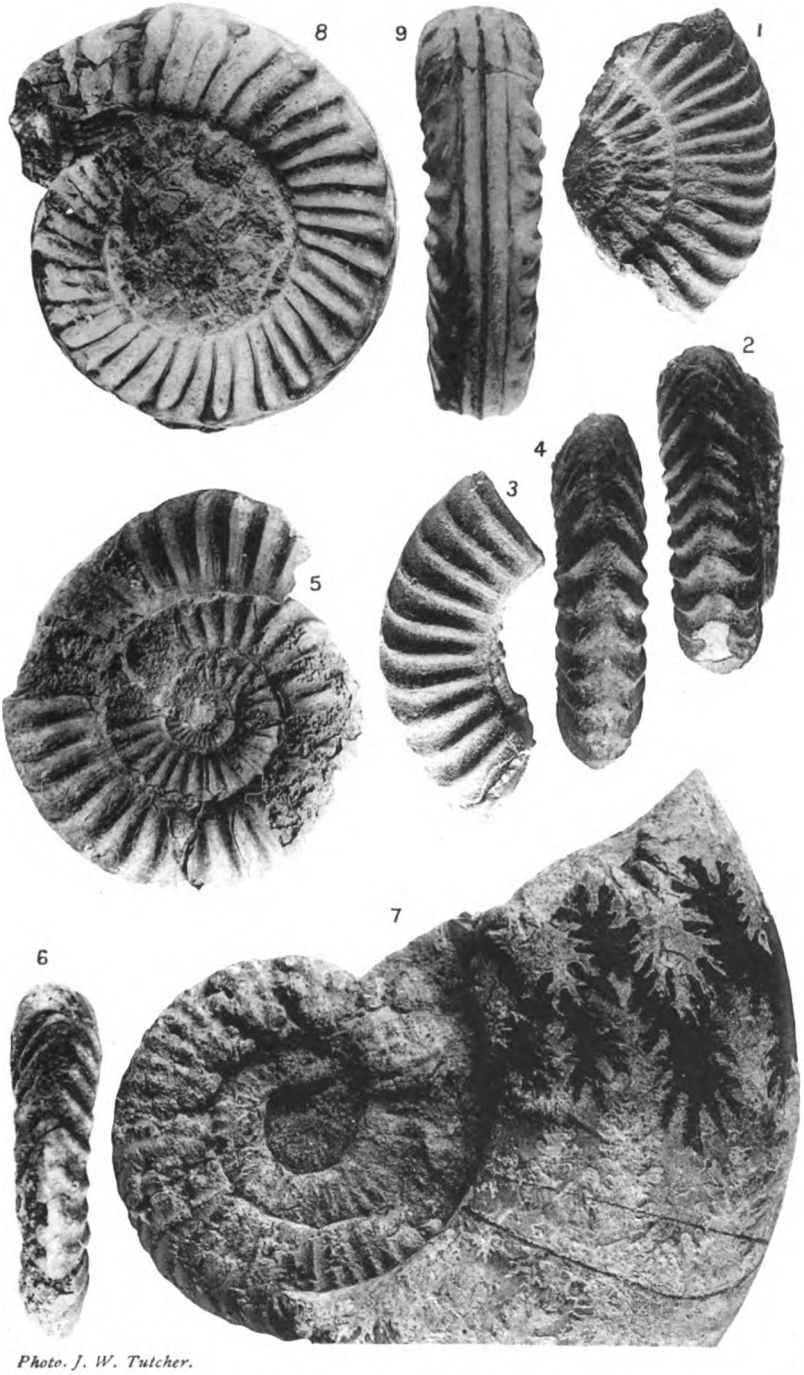


*Photo. J. W. Tutcher.*

SCHLOTHEIMIA, CORONICERAS

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# NOTES ON SOME NATURAL CONDITIONS AFFECTING THE LOCATION AND STORY OF GLOUCESTER

BY

F. J. CULLIS, F.G.S.

(Delivered March 20th, 1906)

ABSTRACT BY LECTURER

The history of ancient Gloucester has been shewn by eminent local antiquaries to extend back to Roman times with sufficient incident and certainty to make it both interesting and reliable. But the very little we now know of its still earlier Celtic and Pre-Celtic story is fragmentary and obscure.

It may be suggested that it is in the knowledge of the natural conditions which obtained hereabouts in those early days, that we must seek for the most reliable foundation for as much of our local history in that dim past as we may now, or hereafter, be able to establish.

This knowledge would at least determine some of the limits and possibilities of the story, and it should serve to

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detect and eliminate erroneous or impossible fancies which, where so little has been known, may easily have crept into common acceptation.

Only by carefully working back from the well-known present to the more and more distant past, making due allowance for the accumulating effects of natural changes and for the improvements effected by the action or agency of man, can this knowledge of the former state of local natural conditions be gained. It will of course be wise to consider as well the more purely human aspect of the story, since in many ways the natural conditions prevailing at any time will be reflected in its history. But it will be necessary to distinguish carefully between developments growing directly out of the natural conditions, and many others of a secondary character, which have arisen out of the mere convenience presented by such population and organization as had from time to time become already established here.

The present-day manufacturing prosperity of Gloucester is an instance of such an incidental or secondary development. But in the remarkable inland seaport element in the history and character of Gloucester we come upon a primary product of local natural conditions. Located not only on a navigable portion of the Severn, with its phenomenal tides, Gloucester occurs just where the uniformly single broad channel of the river was notably interrupted by a group of alluvial islands, the largest of which, the Isle of Alney, still remains as such.

It is contended that by following up this clue, noting the smaller and smaller resources of early navigators, and the variations in their needs and purposes, at the same time working back step by step to an adequate realization of the natural condition of the river, its islands, its adjacent shores and their inland neighbourhood, as they existed two or three thousand years ago—that thus and thus only

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can we become competent to imagine even in outline, the earlier chapters in the story of this ancient abode of men. Here, as in many another field, the naturalist and the archæologist must work hand in hand. In this way, it is believed, we shall be led to at least the following definite and general conclusions.

*First.*—That the Celtic "Caer Glow" did not occupy the site on which, in succession to the Roman fortress, modern Gloucester now stands, but enclosed a much smaller area on lower ground a little to the north.

*Second.*—That this same "Caer Glow" was not in Celtic times the "Fair City" of which our local poets have been wont to dream, but was a mere out-post of a civilization whose centre was to be found on higher ground and far inland.

*Third.*—Whereas it has been suggested that it was a convenient ford across the river here, which determined the location of both the Celtic and Roman strongholds, the contrary would seem to be true, the secret of the military importance of the position at Gloucester being found in the network of alluvial islands and the intervening channels which, with their beds of mud soft as cream, made it practically impossible for the Severn to be forded or forced anywhere abreast of Gloucester.

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# OPENING OF A ROUND BARROW

## NEAR HARESFIELD, GLOS.

BY

**WILLIAM BELLOWS**

High up on the Cotteswolds, about one mile to the east of the Roman Camp at Haresfield, and close to the road from there to Horsepools, is a round barrow in the middle of a field. It stands not far from the edge of the woods overlooking Standish Park, at 825 feet above sea-level—a fitting spot, indeed, for the resting-place of some Cotteswold hero of a far-off age.

In the autumn of 1903, I obtained leave to excavate this barrow[1]; and with the help of friends a trench was cut into its eastern face. By a stroke of good fortune we began our digging at the right point, for at a very few feet in, and close to the ground-level, a lump of limestone gave way to the pick-axe and revealed a beautiful stone cist, arched over with carefully poised slabs. It was pentagonal in shape and measured 2 feet 6 inches across, its perfectly level floor being composed of burnt earth some 4 to 5 inches deep. This earth, carefully removed in a sack, was found to contain fragments of human bones (portions of jaws with teeth in position, ribs, skull, &c.) all more or less distorted by partial cremation. These bones were subsequently identified for us by Dr Beddoe. The most interesting "find," however, was a small, beautifully formed oval flint scraper (?) 2¼ inches × ¾ inch—curved throughout its length and sharpened all round to a fine edge—which lay in one corner of the cist. Except for this, and the above-mentioned remains, nothing else was discovered and no further chamber came to light.

1 It is not shown as one on the Ordnance Map. My friend Alfred E. W. Paine kindly supplies its dimensions as follows: average diameter 63 ft., height above surrounding field 6 ft.

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# ON A SECTION OF LOWER-LIAS ROCKS AT MAISEMORE, NEAR GLOUCESTER

BY

L. RICHARDSON

About two miles north-north-west of Gloucester, is a low river-cliff in which certain Lower-Lias rocks are exposed. The lowest beds are seen at the weir end of the section, where they are almost horizontal. Then comes a disturbance, where the beds are bent into an acute little anticline, after which they dip gently to the south-south-east.

Although so near to Gloucester, this section has never been described. Unfortunately it has not been possible as yet to obtain the exact date of the beds. I have searched them for ammonites on several occasions, and so has Mr Paris. But the only specimens obtained were much crushed, so that Mr Buckman, who kindly examined them, could only report that they appeared to be species of *Arnioceras* and would therefore indicate *Birchi* hemera, "but this," he added, "must be considered tentative."

My object in recording this section is to draw attention to the abundant occurrence of Foraminifera at this locality; since very few species have hitherto been recorded from the Gloucestershire Lias. Those hitherto recorded are *Cornuspira infima* (Strickland), *Involutina liassica*, Jones, and *Polymorphina fusiformis*, Roemer.

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RIVER-CLIFF, MAISEMORE.

| | | Thickness in Feet | inches |
|---|---|---|---|
| | QUARTZITE-PEBBLES, etc. | | |
| 1 | CLAY, marly, pale-yellow and bluish-grey, often indurated so as to constitute intermittent argillaceous limestone-bands, the most important of which occurs at 2 feet 10 inches above bed 2, is from 0 inch to 5 inches thick, and contains Foraminifera. At 1 foot 4 inches above bed 2, is a zone of thinly-laminated black shale full of a species of *Pseudomonotis*. In the clay immediately above the limestone-bed were found numbers of scales of *Eugnathus*; *Lingula?* (fragment). About ... ... ... ... | 12 | 0 |
| 2 | CLAY, black, laminated ... ... ... ... | 0 | 8 |
| 3 | LIMESTONE, grey, weathers yellowish: almost made up of the ossicles of *Pentacrinus tuberculatus*, Miller: 0 inch to 3 inches ... ... ... | 0 | 1 |
| 4 | CLAY, blue, imperfectly laminated except near the centre where it is thinly laminated and contains in great abundance *Pseudomonotis?* ... ... | 2 | 0 |
| 5 | LIMESTONE, crowded with *Pentacrinus tuberculatus*. When the limestone is absent the ossicles occur in the clay; 0 inch to 3 inches ... ... | 0 | 1 |
| 6 | CLAY, blue; *Gryphæa arcuata* (Lam.), *Pentacrinus* | 0 | 9 |
| 7 | LIMESTONE, ripple-marked: *Gryphæa arcuata*, *Pentacrinus*; 0 inch to 2 inches ... ... ... | 0 | 1 |
| 8 | CLAY, blue, laminated at horizons equally spaced; *Gryphæa arcuata* abundant (small), *Arnioceras?*: 1 foot 8 inches to 2 feet ... ... ... | 1 | 10 |
| 9 | CLAY, blue, imperfectly laminated, impure limestone in places. Crowded with Foraminifera (see list), and Ostracoda; *Pholidophorus?* (scales), *Hybodus delabechei*, Charlesworth, *Lima* (*Plagiostoma*) *gigantea* (Sowerby), *Gryphæa arcuata*, *Nuculana* sp. ... ... ... ... ... | 6 | 6 |
| 10 | CLAY, blue, tough. Top layer crowded with *? Pseudomonotis papyria* (Quenstedt), and another species... ... ... ... ... | 0 | 8 |

The lamellibranch recorded above as *Pseudomonotis papyria* (Quenstedt), was provisionally identified with this form by Mr E. T. Newton, F.R.S.

I am indebted to Mr Joseph Wright, F.G.S., of Belfast, for kindly determining the forms. That entered on the list as *Cornuspira infima* (Strickland), was identified by

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Mr Wright with *C. cretacea*, Rss., but as Prof. J. F. Blake, F.G.S., who also examined the specimens, suggested, it is more likely to belong to the former species.

FORAMINIFERA.

| SPECIES : | REMARKS : |
|---|---|
| *Spiroloculina acutimargo*, Brady. | Rare. Specimen rather small. |
| *Cornuspira infima* (Strickland). | Rather rare. |
| *Haplophragmium irregulare* (Röm.). | Common. |
| *Ammodiscus incertus* (d'Orb.). | Rare. |
| *Involutina liassica* (Jones). | Common. |
| *Lagena elongata* (Ehr.). | Rather rare. |
| *Nodosaria radicula* (Linné). | Very rare. |
| *N. pauperata*, d'Orb. | Rather rare. |
| *N. communis*, d'Orb. | Very common. |
| *N.* " var. *filiformis*, d'Orb. | Rather rare. |
| *N.* " var. *Lorneiana*, d'Orb. | Rare. |
| *N. arundinea*, Schw. | Very rare. |
| *N. paucicosta*, Röm. | Very common. Specimens large. |
| *N. raphanistrum* (Linné). | Very common. |
| *N. obliqua* (Linné). | Common. |
| *Lingulina carinata*, d'Orb. | One specimen. |
| *L. striata*, Tate and Blake. | Common. |
| *Frondicularia intumescens*, Born. | Rare. |
| *F. bryæformis*, Born. | Frequent. |
| *F. striatula*, Rss. | Very rare. |
| *F. multicosta*, Terquem. ? | Very common. |
| *Marginulina ventricosa*, Terq. | Very rare. |
| *M. costata* (Batsch). | Long slender variety. One specimen. |
| *Vaginulina Roemeri* (Rss.). | Rather rare. |
| *V. depressa* (Tate and Blake). | Rare. |
| *V. anomala*, Tate and Blake. | Very rare. |
| *V. inæquistriata* (Terq.). | Common. Specimens large. |
| *Cristellaria ensis* (Rss.). | Common. |
| *Vitrowebbina irregularis* (d'Orb.). | Frequent. |
| **Nodosaria burgundiæ*, (Terq.) | Four specimens. |
| **N. tecta*, (Terq.) | Three specimens very near Terquem's species. |
| **Frondicularia nodosaria*, Terq. | Somewhat common. |
| **Cristellaria*, sp. | Not uncommon. |

Some of the material that Mr Wright returned to me after he had washed and examined it,I gave to Mr Charles Upton, who reported that he found several specimens not noticed by Mr Wright. The names of these additional specimens provisionally identified by Mr Upton are indicated by an asterisk in the above list.

Mr Wright also found several forms of ostracods and the plates and spicules of a holothuroid. Concerning these spicules and plates, "which occurred in abundance," Mr

T

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Wright wrote (*in litt.*, Nov. 6th, 1904), " not knowing the form, I sent specimens to Dr G. J. Hinde. In a letter which I received from him he enclosed a tracing of a very similar form discovered by Robert Etheridge, junr., in the Carboniferous of Scotland, and named by him *Archistrum Nicholsoni*. In this the hooks are similar to the Liassic ones, but the plates differ in being circular and not oblong as they are in the Liassic species. I have given it the MS. name of *A. liassicum*, but as it is so abundant in the shale it may possibly have been figured and described already."

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# ADDITIONAL NOTES

# ON THE DENNY-HILL SECTION

## NEAR MINSTERWORTH, GLOUCESTERSHIRE

BY

**E. TALBOT PARIS**

The Denny-Hill Section, near Gloucester, has been described by Mr Richardson in a paper communicated to this Club,[1] but since then a slip has occurred which has exposed higher beds to view. As this section is of considerable importance, Mr Richardson asked me to measure and describe the additional beds. These are beds 2-5, and it has also been possible to obtain the precise thickness of bed 8, which measures 5 inches in excess of the thickness given by Mr Richardson.

SECTION AT DENNY HILL, MINSTERWORTH, NEAR GLOUCESTER

| | | | *Thickness in* Feet | inches |
|---|---|---|---|---|
| Upper Rhætic | 2 a. | CLAY, blue and yellow, very ferruginous clayey deposit, about ... ... ... ... ... | | 5 |
| | b. | CLAY, marly, pale-grey ... ... ... | 1 | 0 |
| | 3 | LIMESTONE, whitish-grey, intermittent, *Estheria minuta* var. *Brodieana* ... ... ... | | 0-4 |
| | 4 | MARL, whitish-grey ... ... ... ... | 4 | 6 |

1 Proc. Cotteswold Nat. F. C., vol. xiv., pt. 3 (1903), p. 254.



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| | | | Thickness in Feet | inches |
|---|---|---|---|---|
| Lower Rhætic | 5 | SHALES, coarsely laminated; *Schizodus* ... | 1 | 2 |
| | | LIMESTONE, earthy, similar to bed 7: *Pecten (Chlamys) valoniensis* ... ... ... | | ½ |
| | 6 | SHALES, coarsely laminated; *Schizodus Ewaldi*, *Myophoria*, *Pteria contorta*... ... ... | 1 | 0 |
| | 7 | LIMESTONE, greenish-brown, somewhat earthy; *Pecten valoniensis*, *Pteria contorta*, shell-débris, fish-scales ... ... ... ... | | ½ |
| | 8 | SHALES, black, imperfectly laminated, with sandstone-layers near the base ... ... | 2 | 2 |
| | 9 | SHALES, black, thinly laminated; constitute a conspicuous feature ... ... ... | 1 | 11 |
| | 10 | SHALES, black, coarsely laminated ... ... | 1 | 6 |
| | 11 | SANDSTONE, yellowish-white, micaceous, calcareous; layer intermittent ... ... ... | | ½ |
| | 12 | SHALES, black; lower 4 inches earthy; upper 7 inches clayey; *Schizodus Ewaldi*, Selenite | | 11 |
| | 13 | SANDSTONE, very pyritic; *Acrodus minimus*, *Gyrolepis Alberti*, *Saurichthys acuminatus*, (½"—1½".) Selenite on upper surface | | 1 |
| | 14 | SHALES, black, clayey, with thin pyritic sandstone layers (6"—10") ... ... ... | | 8 |
| | 15 | SANDSTONE (Bone-bed); highly pyritic, coarse-grained in places, small quartz pebbles; *Acrodus minimus*, *Gyrolepis Alberti*, teeth of *Gyrolepis?* and *Saurichthys acuminatus* ... ... ... ... ... | | 0-1 |
| Upper Keuper | I. | "Tea-green Marls." Greenish-grey marls (weather-whitish,) angular fracture; hard zone 6" to 8" thick near top ... ... ... | | |
| | II. | Red Marls seen in road ascending the hill to the cottage ... ... ... ... ... | | |

The importance of this section lies in the fact that there are no *Pullastra*-Sandstones. The Bone-bed rests directly upon the "Tea-green Marls" of the Keuper, all the infra-bone-bed deposits of Garden Cliff being absent from here. Whilst at Garden Cliff the Lower Rhætic measures 19 feet 8½ inches, at Denny Hill it measures only 9 feet 7 inches. So reduced a thickness for the Lower-Rhætic beds is seldom obtained.

When, on June 14th, 1904, a party of this Club visited the outlier of Rhætic and Lower-Lias rocks of Berrow

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Hill, which is distant about 2 miles in a south-easterly direction from Chase-End Hill, the southern end of the Malvern range, Mr Richardson said that he purposed making an excavation with a view to seeing what beds were present. Since then the excavation has been made, and it showed that the Lower Rhætic was only about 9 feet thick—7 inches less than Denny Hill.[1] At Lilstock, near Watchet, which I visited in company with Mr Richardson in 1905, the Lower-Rhætic Black Shales are about 38 feet thick. Thus it will be seen that the Black Shales vary considerably in thickness at different localities in the West of England, much more, indeed, than is generally realized.

The *Estheria*-Bed in this section is a pale-cream coloured argillaceous limestone in which several examples of *Estheria minuta* var. *Brodieana* were found. There are several lithic varieties of the *Estheria*-Bed, of which that seen in the section is one. Another, namely, that with arborescent markings, has been found by Mr Richardson in the lane-cutting on the other side of the hill, and it is this development of the bed which might be mistaken by some for Cotham Marble. The *Estheria*-Bed is the most persistent deposit in the Rhætic Series of the West of England, being easily identifiable in sections so far apart as Garden Cliff, Westbury-on-Severn and Culverhole, near Axmouth. When this horizon is found in a section it is a comparatively easy matter to correlate the remaining Upper-Rhætic deposits with those seen at other localities. Hence to find the bed *in situ* at Denny Hill was very satisfactory. The Upper Rhætic deposit below the *Estheria*-Bed at Garden Cliff measures 5 feet 6 inches; at Denny Hill the equivalent deposit is 4 feet 6 inches. In the case of the Upper Rhætic, then, as in the lower division, there is a reduction in thickness. This fact is interesting

1 Quart. Journ. Geol. Soc, vol. lxi, (1905), pp. 425-430.

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when it is remembered that Denny Hill is situated approximately half-way between Garden Cliff and Lassington, the latter a locality where the Rhætic Series is apparently exceptionally thin.

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# ON THE OCCURRENCE OF *CERATODUS* IN THE RHÆTIC AT GARDEN CLIFF, WESTBURY-ON-SEVERN, GLOUCESTERSHIRE

## WITH SOME REMARKS UPON ITS DISTRIBUTION IN BRITISH FORMATIONS

BY

**L. RICHARDSON**

At the time my paper on "The Rhætic Rocks of North-West Gloucestershire" was published, there was no satisfactory record of *Ceratodus* teeth from the Rhætic of Garden Cliff, Westbury-on-Severn.[1] A tooth of this fish had been mentioned by Dr T. Wright, as having been found in the Bone-Bed,[2] but it was not clear whether he had procured it himself, or had listed it on the authority of Richard Gibbs, the late fossil-collector of the Geological Survey.[3]

In 1905, however, Mr P. C. A. Stewart, one of a party from the Royal College of Science, who visited the locality under the guidance of Dr C. G. Cullis, found in the Bone-

1 Proc. Cotteswold Nat. F. C., vol. xiv. (1903), p. 161.
2 Quart. Journ. Geol. Soc., vol. xvi. (1860), p. 378.
3 Mem. Geol. Surv., "The Geol. of the County arouud Cheltenham" (1857), p. 16.

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Bed (15) *in situ* the well-preserved tooth represented in annexed figure.

The teeth of *Ceratodus*, upon which Agassiz originally founded several "species," came from Aust Cliff on the Severn. E. T. Higgins also collected a number of specimens at the same locality, and as several of them appeared

Fig. 1. TOOTH OF *CERATODUS LATISSIMUS*, L. AGASSIZ.
Garden Cliff, Westbury-on-Severn.

distinct from known forms, he gave them specific names.[1]

Beyrich recognised that it was undesirable to thus multiply names, and suggested that the name *Ceratodus anglicus* should replace them all.[2]

Prof. L. C. Miall came to a very similar conclusion, but instead of one, made two groups. In the one group he collected the large teeth of very variable form, and distinguished them by the name *Ceratodus polymorphus*. He did not employ Agassiz's names, such as *Ceratodus altus*, *C. emarginatus*, etc., because they were too descriptive. In the other group he included the smaller and more

1 In Morris' Catal. Brit. Foss. (1854, 2nd ed.)
2 E. Beyrich, Zeitschr. deutsch. geol. Gesell., vol. ii. (1850), p. 159.

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constant forms, and described them under Agassiz's name of *C. parvus*. Whilst admitting two specific names, he remarked that a fuller series of teeth might demonstrate that there was only one.[1]

Dr A. Smith Woodward holds Beyrich's view that there is one only species of *Ceratodus*, but employs neither the German nor the English Professor's designation, but Agassiz's name *C. latissimus*, because it "is sufficiently appropriate to secure priority, and must be adopted."[2] The specimen from Garden Cliff must then be called *Ceratodus latissimus*, L. Agassiz.

Most of the teeth of the *Ceratodus latissimus* from the British Rhætic have come from Aust Cliff. Mainly through the exertions of Higgins, there are 350 specimens from this locality in the Bristol Museum, and useful series are possessed by the British Museum and the Museum of Practical Geology. The known records are appended:

| | | | |
|---|---|---|---|
| 1 | *C. latissimus*, | Agassiz. | Blue Anchor, near Watchet, West Somerset. (Collected by S. G. Percival and deposited in the British Museum, Nat. Hist.) |
| 2 | " | " | "Dyke" (fissure filled up with Rhætic and Liassic rocks) in the quarry at the back of the Inn, Holwell, near Frome, Somerset. (Collected by L. Richardson.) |
| 3 | " | " | Aust Cliff, near Patchway, near Bristol. |
| 4 | " | " | Redland (or New Clifton), Bristol. (Collected by W. H. Wickes.)[3] |
| 5 | " | " | Pylle-Hill railway-cutting, Bristol. (Collected by the late Edward Wilson.)[4] |

1 Monogr. Sirenoid & Crossopt. Ganoids, Pal. Soc. (1878), p. 28.
2 Trans. Leicester Lit. and Phil. Soc., n.s., pt, xi. (1889), p. 21.
3 "One small piece, very badly preserved, found on a loose block." W. H. Wickes, *in litt.*, July 21st, 1906.
4 Quart. Journ. Geol. Soc. vol. xlvii (1891), table facing p. 546, and Trans. Bristol Nat. Soc. vol. vii., pt. 3 (1893-94).

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| | | | |
|---|---|---|---|
| 6 | *C. latissimus*, Agassiz. | | Lilliput, railway-cutting, near Chipping Sodbury. (Dr A. Vaughan and Prof. S. H. Reynolds.)[1] |
| 7 | " | " | Garden Cliff, Westbury-on-Severn. (Collected by P. C. A. Stewart, and deposited in the Museum of Royal College of Science). |
| 8 | " | " | Spinney Hills, near Leicester. (W. J. Harrison[2]; see also H. E. Quilter.)[3] |
| 9 | " | " | Stanton-on-the-Wolds, Nottinghamshire. (E. Wilson.)[4] |
| 10 | " | " | Penarth, near Cardiff. (Collected by W. H. Wickes).[5] |

Thus *Ceratodus latissimus* has been recorded from the Rhætic at ten different localities in Britain.

There are two records of the teeth of *Ceratodus* from rocks other than Rhætic in this country.

In the British Museum (Nat. Hist.) there is a specimen labelled *C. lævissimus* from the " Bone-Bed " in the Upper Keuper Sandstone which was formerly exposed in the railway-cutting at Ripple, near Tewkesbury. It is not known who gave the specimen this name; it may have been the Rev. W. S. Symonds.[6] Prof. Miall states in his monograph that the specimen does not resemble those from the Rhætic, but those from the German Trias.[7]

The other record is from the Stonesfield Slate of Stonesfield. The specimen was sent to Agassiz for description by Prof. Phillips.[8] Agassiz named it *Ceratodus*

1 Q. J. G. S., vol, lx. (1904), p. 209. " A good number of pieces have been found, but anything like a perfect specimen is rare, and they are all of the small flat type (*C. parvus*, Ag.). They are more plentiful in the lower bed on the old Red Sandstone than in the higher one on the Carboniferous Limestone." W. H. Wickes, *in litt.*, July 21st, 1906.

2 Q. J. G. S., vol. xxxii. (1876), p. 213.

3 Trans. Leicester Lit. and Phil. Soc. (1889), p. 17.

4 Q. J. G. S, vol. xxxviii. (1882), p. 452.

5 " Only in the lower bed [i.e. the 'Fish-Bed': see L. Richardson, Q. J. G. S., vol. lxi. (1905), pp. 391, 392.,] and mostly in a bad condition and much weathered. Only a few fragments have been obtained." W. H. Wickes, *in litt.*, July 21st, 1906.

6 *Vide* Proc. Cotteswold Nat. F. C., vol. xiv., pt. 2 (1903), p. 134.

7 Page 32.

8 " Manual of Geology " (1855), table on p. 324.

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*Phillipsi*.[1] The holotype is lost, but what may be a topotype is in the British Museum, and has been figured by Prof. Miall.[2]

"In 1870, the Hon. D. Forster shewed to the Curator of the Sydney Museum, a cartilaginous fish that lived in Queensland, and whose teeth corresponded in every respect with those of the fossil Ceratodus."[3]

Such fish are called by the natives "Barramanda" and have been caught in the Mary, Dawson, and other rivers in Queensland. They are vegetable feeders and live in muddy creeks. When the hot weather sets in they bury themselves in the mud until the return of the wet season. It is interesting to notice that the habitat of the recent fish appears to be very similar to what we know must have been that of the Rhætic fish.

1 Poissons Fossils, t. iii., pp. 135, 176.
2 Monogr. Sirenoid & Crossopt. Ganoids, Pal. Soc. (1871), pp. 26, 32.
3 W. W. Stoddart, Proc. Bristol Nat. Soc., vol. i., pt. 2. (1874-75), p. 145.

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